A close-up photograph of several bamboo stalks in a forest. The stalks are vertical, showing their segmented structure with nodes. The colors range from light green to dark brown, with some areas appearing weathered or covered in moss. The lighting is soft, creating a natural, serene atmosphere.

THE BOOK OF BAMBOO

BY DAVID FARRELLY

THE
BOOK
OF
BAMBOO

DAVID FARRELLY

Sierra Club Books • San Francisco

The Sierra Club, founded in 1892 by John Muir, has devoted itself to the study and protection of the earth's scenic and ecological resources—mountains, wetlands, woodlands, wild shores and rivers, deserts and plains. The publishing program of the Sierra Club offers books to the public as a nonprofit educational service in the hope that they may enlarge the public's understanding of the Club's basic concerns. The point of view expressed in each book, however, does not necessarily represent that of the Club. The Sierra Club has some fifty chapters coast to coast, in Canada, Hawaii, and Alaska. For information about how you may participate in its programs to preserve wilderness and the quality of life, please address inquiries to Sierra Club, 530 Bush Street, San Francisco, CA 94108.

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Barefoot Bamboo

*To the immense millions of the most penniless,
who would most benefit from bamboo abundance,
the people, the forever forgotten ones who
can't afford a book on bamboo or anything else,
whose bare feet never wander stores in cities
where such information is sold,
who don't have the data and dollars
to search for the species most suited
to their weather and needs,
nor land to plant nor time to wait
until a grove becomes established,
who lack traditions of bamboo know-how
to guide in care, harvest, and use;
who often have never seen and can't afford a tool
more costly or specialized than a machete,
whose daily battle for barest subsistence leaves
little curiosity or energy for the unknown;
whose long historical experience has taught
a salutary distrust of anybody better dressed
or fatter fed coming toward them
with some bright message to better their lot . . .*

*to those who will never see or touch or hear of it,
who couldn't read it, in any case,
this book is affectionately dedicated.*

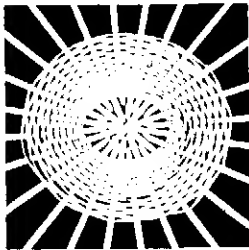


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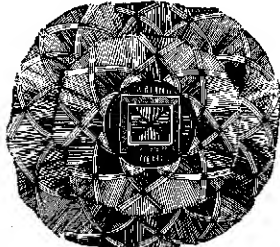
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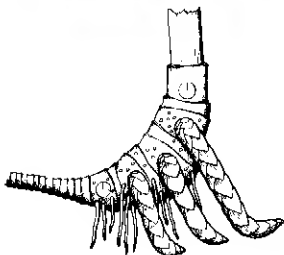
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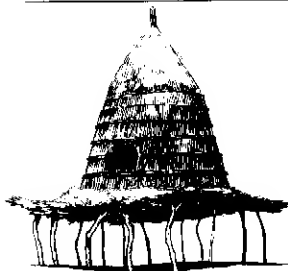
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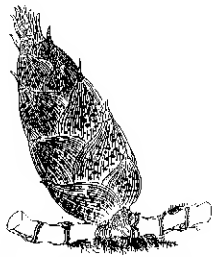
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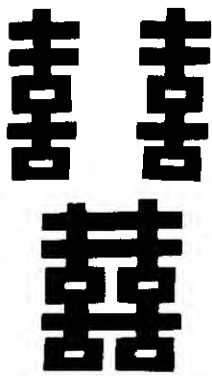
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ACKNOWLEDGMENTS

A glance at the ample footnotes, bibliography and masses of quoted matter in this book will indicate to the most casual reader its collective nature. A summing up of the relevant past scholarship on bamboo in a work intended for a broad public must inevitably rely on the many long years of the work of others, often under very difficult circumstances, usually with no public recognition beyond a small circle of professional friends. Impossible to acknowledge all that sufficiently.

I have been more of an editor than an author, a crow strutting in feathers of peacocks. This exercise has been fed, sheltered, and endured by friends longer than the best of them often felt possible, and unfailingly encouraged by the living bamboo lovers whose paths crossed its composition—among them, Thomas Soderström and Cleofe Calderon at the Smithsonian Institution in Washington, D.C., Oscar Hidalgo and Dickens Castro in Bogotá, Colombia, and Ruth McClure, the widow of Floyd A. McClure, whose life work both inspired this book and furnished much of its matter.

The staff at Sierra Club Books in San Francisco has patiently drawn order from the confusion of thousands of scraps of manuscript, illustrations, captions, boxes, tables, and whatnot, after waiting for them some three years beyond our contracted deadline. Gratitude to Eileen Max, David Spinner, L. Jay Stewart, Cathy Flanders, and Danny Moses. Among hundreds who helped, special thanks to Stuart Chapman, who drew or retouched or redrew from poor xeroxes most of the many illustrations; to Kevin Quigley, who shared this work in many weird ways for five years and provided photographs; and to Julia Foster for drawings, as well as prolonged active support of this obsession, toiling and traveling in the shadow of bamboo through some dozen countries, while giving birth to our children, Sasa and Jesse, en route.

PREFACE

A PLANT PROFILE

Bamboo grows more rapidly than any other plant on the planet. It has been clocked surging skyward as fast as 47.6 inches in a 24-hour period. Astonishing vitality, great versatility, lightweight strength, ease in working with simple tools, striking beauty in both its natural and finished state—these qualities have given bamboo a longer and more varied role in human cultural evolution than any other plant. It has been most widely used for shelter, food, paper and countless articles of daily life like chopsticks, mats, and baskets. But in addition to its more common tasks, bamboo has run a hundred hidden errands in human history, huge and minute, crude and fine, dramatic and humdrum, from skyscraper scaffolding in Tokyo and phonograph needles in America to slide rules, skins of airplanes, and diesel fuels. Medicines for asthma, hair and skin salves, eyewashes, potions for lovers and poisons for rivals have all been extracted from different portions of the plant; and even the ashes of bamboo are used—to polish jewels and manufacture electrical batteries. The range of its uses is perhaps unequalled by any other resource: it has been employed in bikes, dirigibles, windmills, scales accurate enough to weigh crickets, and retaining walls strong enough to resist flood and tide. Split and twisted into 21-inch diameter cables, bamboo built bridges up to 750 feet long in China; and bamboo fibers provided Edison, after fruitless experiment with other materials, with a successful filament in the first light bulb, a bridge of light.

Ancient resident of earth, among the most primitive of grasses, here before

people by some 100 to 200 million years, bamboo is also the first born, the Adam of the Atomic Age, through its survival of Hiroshima closer to ground zero than any other living thing. Its root-like "rhizome" and "culm"—as the stalk is called—compose perhaps the hardest natural structure to evolve in millions of years of restless experiment in cellular life on earth, and the most efficient laboratory that has yet appeared for braiding sunlight, water, and soil into forms which have for centuries proved super-useful for human needs.

Bamboo is cosmopolitan in habitat, a plant with a thousand faces, a miracle mutant of adaptive forms: It tolerates extremes of drought and drowning from 30 to 250 inches of annual rainfall. It thrives in some twelve to fifteen hundred species that are native to every continent but Europe and the poles, from sea level to 12,000 feet in elevation, ranging in form from scrubby bushes used principally for cattle fodder to towering culms 120 feet high that provide sturdy beams with a diameter of nearly a foot and walls an inch or more thick. Abnormal culms of 150–180 feet are also recorded.

Although there are species that flower annually, bamboo normally reproduces asexually, without flowering and without seeds. New sprouts shoot up from the rhizomes, the underground growth that is squat and creeping in clumping tropical "sympodial" species, but in temperate "monopodial" free-standing bamboo resembles a subterranean spaghetti of long, tangled runners that are jointed like the culms above. The ordinary method of bamboo propagation is transplanting

rhizomes, not planting seeds. However, at intervals depending on the species, sometimes as seldom as once a century, in obedience to some clock ticking in their cells all the bamboos of a given kind, even groves from rhizomes transported generations before to distant countries, flower together around the world—and die. Seeds of bamboo are produced at this time only, but in sufficient abundance to have provided famine relief in India more than once in the history of that hungry country.

The importance of bamboo at the earliest, most formative periods of human culture is suggested by the fact that it was deified in some primitive tribes, such as the Piyoma of Formosa. In others, man and woman were said to have issued from different joints of a single culm. The earliest mention of bamboo in planet letters is in perhaps the oldest book alive and breathing, the I Ching, the Book of Changes. Disguised as an oracle, it contained the political mysticism of ancient China, a dense and handy guide to Change Design. Noting that change was the only constant, the sages of old playfully created

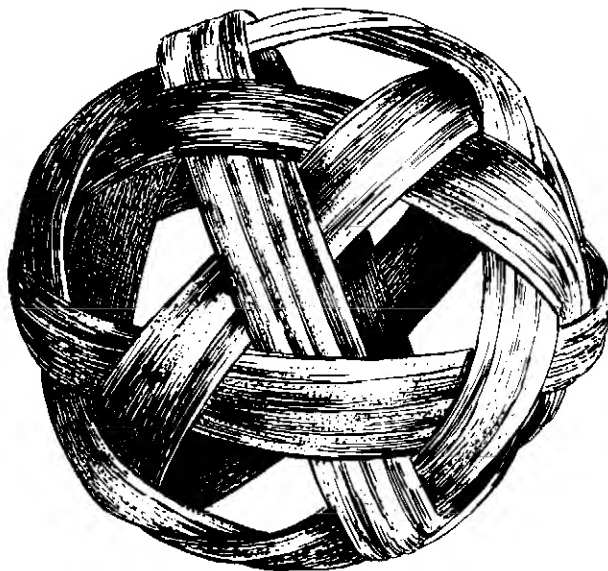
in the book an intriguing game to help apprentice sages roll strategically with transformation rather than fruitlessly resisting it or trusting to blind luck.

For one of China's most admired virtues, limitation, the sages chose the most distinctive feature of her favorite plant—the joints of bamboo. Observing that bamboo attained its astonishing and useful altitude by throwing a horizontal truss across at distances carefully determined by stress levels in the ascending culm, they used the node as an image of the adaptive aim that tacks with diplomacy through the crosswinds of social existence; of the thrift and measure that gives duration to all economies from the poorest peasant to the Sun of Heaven and his state; and of the central modesty that best befits the spirit of a tiny creature briefly wandering mountains and rivers without end. What constitutes proper "limits of growth" is a theme of present-day economic debate. It is interesting that bamboo, which has extended its life limits further than most organisms in duration, distribution, and rambunctious vitality, is first cited in world literature as a symbol of a sane restraint.



*"The most useful service
we can render a culture
is to add a new plant
to its agriculture."*

—THOMAS JEFFERSON



• DAWN IN THE WEST

Begin with your conclusion.

—MONTAIGNE

HERE COMES EVERYBODY

Bamboo is a plant of ancient and increasing importance for humanity. Known as “the wood of the poor” in India, “the friend of the people” in China, “the brother” in Vietnam, bamboo is much less known in the West than it soon will be. Increased population increases importance of the Great Yields, such as bamboo, leucaena, eucalyptus . . . rabbits. Superproductive plants and animals will be increasingly investigated as our own species becomes ever more productive. And bamboo, under optimum conditions, can provide two to six times as much cellulose per acre as pine. Forests in general increase 2 to 5 percent yearly in total bulk or “biomass”; groves of bamboo increase 10 to 30 percent.

Through a tube, darkly: a brief fit of prophecy.

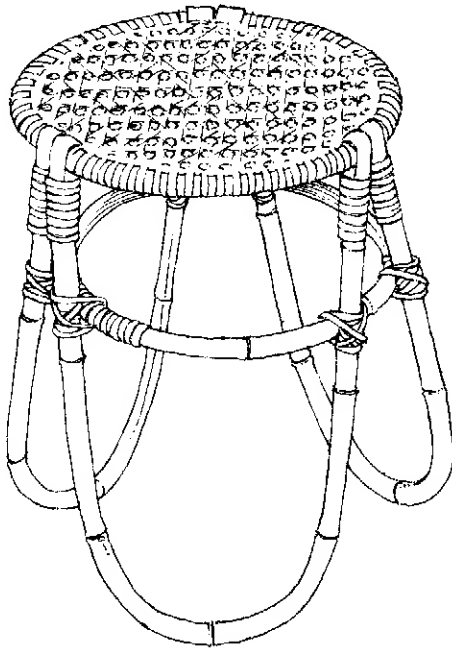
World shelter and paper shortages will inspire looking closer at bamboo’s traditional oriental roles and

Bamboo ball, Burma. This form is common in many oriental countries.

modern variants. Lamination, plybamboos, reinforced bamboo-cement, and veneers will increase use of bamboo in housing as much as modern papermaking machinery in India has increased volume of bamboo used for pulp. Some 35 to 40 paper factories in India used 2.2 million tons of bamboo in 1980 to make 600,000 tons of paper, 70 percent of their total paper production. Developing countries generally will become more paper conscious, alert to paper’s economic, political, and cultural implications. Schools will begin to study and make paper, the unexamined basis of modern education, curiously exiled from the curriculum it makes possible.

Learning revolution.

The quite recent idea of universal education, now shared worldwide, is occurring at a time of unprecedented global population growth. Raw materials to make schools and to teach children to make and build and read and write in them are increasingly expensive. Cost-per-student is a critical aspect of all education design. Bamboo’s abundant growth, lightweight workability, and paper history



*I never saw so fine a chair
as one which mostly
wasn't there,
fashioned of the vacant air
and elegantly bent bamboo.*

*If we did everything we do
in a style so spare and
sightly,
building could keep pace
with birth;
our lives, less littered with
our mess,
would sit more lightly
on a wilder earth
and trash it less.*

suggest a possible future in schools of a dimension as yet undreamt by Western educators.

Planetary norm.

"Everybody"—this new idea in education—is the basic idea of revolution also. "Culture" for the few, purchased with ignorance of the many, is no longer a suggestible model for people who have heard other historical alternatives. Bamboo fits the everybody idea. There could never be enough silver flutes to give one to everybody in the world. There could, easily, be enough bamboo for all 50 billion fingers on the earth to make and play their own. Bamboo is a possible planetary norm in the sense that its vitality, wed to human will, could easily

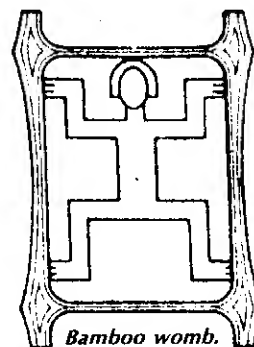
produce enough for everyone, for any of a thousand things.

Bamboo renaissance design.

The industrialization of oriental cultures has introduced many changes in bamboo use there, yet the total volume of bamboo consumption has not diminished but increased. Many more people are turning to its ample capacity to serve human need, and they have devised new, mechanized extensions of ancient uses. For a number of reasons, bamboo diffusion in the West has not kept pace with the expectations of agronomists and plant explorers who have witnessed its wonders in the East—but increasing human populations make it apparent that this prolific old ally of human purposes will reappear among us.

It will be more renaissance than revolution when bamboo returns because the plant was once so intimate a part of some cultures in regions of the Americas that it was mythologized as the womb of the race. Some species were so useful that wide employment without replanting led to the virtual extinction of the best bamboos over vast areas of their original terrains. A bamboo culture in Central and South America would not be an alien introduction but a resurrection of native tradition, fortified by species and know-how from the East and adjusted to the realities of present times.

To any student of change design, a few main rocks in the road of Western bamboo development are readily apparent. Too few bamboo messengers are versed deeply enough in the cultivation and use to pass on the word to others. No bamboo farm and study center exists to train those with an interest in the plant. A number of important species of oriental bamboos have been planted in this hemisphere by the USDA and a hardy handful of botanists in government experimental stations and private groves. But there have been no skilled gardeners of history, "comprehensive, anticipatory culture design sci-



Bamboo womb.

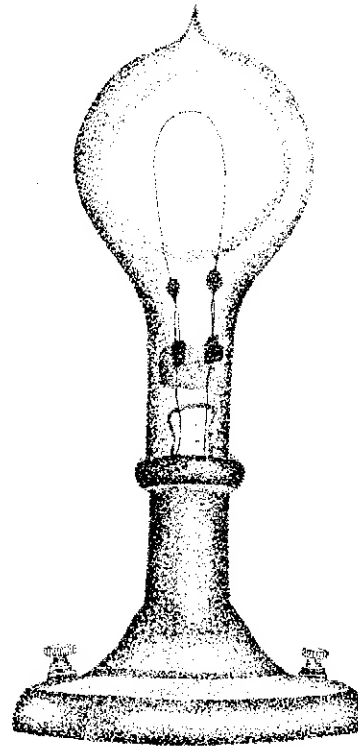
tists," coaxing bamboo roots deep into the daily consciousness of Western peoples. So when Sierra Club Books offered to publish a book on the plant, some friends of bamboo asked themselves: What voice would whisper closest in a Western ear? What was the method, where was a wind to shove back the clouds that smothered up the glory of this bamboo morning in the evening land?

BAMBOO MORNING IN THE EVENING LAND

A century ago, in 1882, golden bamboo (*Phyllostachys aurea*), a hardy Chinese species now known on many an American lawn, was first successfully introduced into the continental United States in Alabama. That same year, Thomas Edison was beginning a light-bulb factory—the world's first—using filaments of bamboo. In 1827, black bamboo (*Phyllostachys nigra*), the first hardy oriental bamboo to find its way west, stepped off a lengthy ocean voyage from Japan into British soil. Two centuries back, in 1789, the first bamboo genus, *Bambusa*, was described properly in the finicky Latin of European botanists—who had no native bamboos to examine—on the basis of a species now called *Bambusa arundinacea*, a thorny staple of India's massive paper trade.

Whatever date we pick as a significant moment of the bamboo bridge gradually arching over oceans from the Orient to us, by comparison with the millennia of highly developed bamboo technology there, widespread growth and use of this grass giant is only dawning in the Euro-American culture that still precariously dominates the West.

But morning becomes noon. The methods for using bamboo within the format of modern industry are multiplying. And researchers are multiplying who recognize that bamboo is equipped to replace in a number of uses—or indirectly decrease consumption of—three resources our century is finding critically scarce as it staggers towards its close with an increasingly crowded globe on its shoulders: wood, metal, and oil. Bamboo is a superrenewable resource, equipped in its genes to multiply at a pace that rivals the proven reproductive capacities of our race. Bamboo is extraordinary in many ways, but the basis for its other wonders is its unparalleled physical vitality, which has made bamboo so plentiful in so many places of the planet for so many centuries that people have found a thousand ways to relate to its other physical properties of strength, weaving ease, lightness, hollowness . . . and visual charm. No other "crop" is so beautiful, with so



Bamboo filament light bulb of Thomas Edison (1882).

many well-mannered and multihandy ways. None other has a past so romantic, complex, and curious, so stuffed with anecdote and legend.

Research gap.

Yet no government in any country in the world is at present funding an adequate program of research and development in bamboo. Even the most bamboo-conscious countries, such as India or Japan, are criticized by their own experts for lagging woefully behind in the possible exploitation of their resources, while in Western countries bamboo study centers are virtually nonexistent.¹ Individual botanists and agronomists in many countries are aware of the immense potential of bamboo, but lack of government funding keeps them from acting on that knowledge with appropriate amplitude.

Some friends of bamboo traveled from the United States to Peru to survey the status of bamboo studies in the West. We found friends of the plant everywhere, lovers of bamboo struggling to make its virtues more widely known: Taiwan experts visiting El Salvador to introduce new species and demonstrate bamboo waterwheels irrigating 129 times faster than a small farmer could by hand;

corporations building tidy and attractive bamboo low-cost housing alternatives, crawling up the mountainsides in Manizales, western Colombia; large bamboo suburbs striding on *mangle* stilts out into the tides in southern Ecuador, near Guayaquil; private planters north of Lima in Peru with huge groves established first as windbreaks on citrus plantations and then used later in a dozen discovered, unexpected ways; and we found one country ready to formally explore a bamboo alliance. From July 1981 to March 1983 we lived in a small basket-making village in Nicaragua, working with various government ministries to evolve a design for comprehensive use of their bamboo resources with particular focus on schools, the small farmer, and the village economy. Our work there is ongoing.

DESIGNING DESIGNERS

Plato, in *The Republic*, raises a question never answered. Any moderately large group requires some apparatus to enact its will—a state. Every state requires guardians who will act as watchdogs against stupidity and corruption. But who will guard the guardians? Victor Papanek, in *Design for the Real World*, rephrases Plato's question in relation to industrial designers. Who shall design them, and how?

Of all the scientists who have ever lived, 90 percent are alive today, exchanging technical information through a hundred thousand journals in over sixty languages. The volume of this information is presently doubling every fifteen years. To package it, papermaking machines now produce in one 24-hour day as much paper as a skilled vat man could make in ten years of 14-hour days working by hand. Newsprint machines 30-feet wide roll out paper at a half mile per minute. The people and technologies are available for communicating viable cultural objectives and enacting appropriate industrial designs—for the many rather than the money.

But the focus of the industrial design profession, according to Papanek, is as if all doctors left general practice and surgery to concentrate on dermatology and cosmetics. Progress—if it is progress—is not keeping pace with people. There are more now without electricity than Before Edison, more without cars than Before Ford. The worldwide shortages of food, fuel, and housing are anxiously discussed on the world's shortage of paper. "There was an old woman who lived in a shoe with too many children to know what to do . . ." The art of annihilation is the only human science that has

managed to keep pace with our race: Bombs are the only artifact we have in sufficient, even excessive, abundance for all. "Overkill"—a very modern word, not needed till now—describes the number of times all the existing bombs on the planet could kill all the existing people.

Reentry.

In this crunch of resources and common sense, it's inevitable that increasingly students of the art of serving life rather than snuffing it should be turning to one of life's most successful designs for living. For all the shortages described above, many looking toward the human future find themselves contemplating hints from our human past—and find bamboo standing by all the centuries on half the globe. The comfy corner supertech has constructed in part of one century of human history is tiny, brief—as selfish as it has been vulgar—and fortunately drawing to a close.

What can we do about it? Rejoin the race, reenter the real world of hunger, scale down our own needs to a feasible planetary norm, and begin to design an educational system for industrial designers in which world need is the prime determinant rather than fadmind. Shortly after this happens—as soon it must—these more humanely designed designers will begin to notice bamboo.

CULTURE DOCTOR, CLIMATE DOCTOR

When Oswald Spengler, the German philosopher of history (1880–1936), decided in *The Decline of the West* ("Evening in the Eveningland" is closer to the German title²) that the sun was setting on Western culture, he was obviously talking about his own cultural corner and economic group. The West wasn't dying. What was dying was the violent unification of the rest by the West. For a while, a large part of the world was united—as a jail is united by guards—by European and then U.S. dominance, through the instruments of war and communications technology, which are now serving to rip the empire apart.

But sundown for the few is dawn to many millions. By the year 2000, for example, some 500 million people will be speaking Spanish in twenty countries with a birthrate unrivaled in the West. Only 50 million or so, roughly 10 percent, will be living in the European country that gave birth, linguistically, to all the rest. By then, the United States and its uneasy alliances will be a shrinking fraction—15 percent—of the countries they confront. These excolonies are now in touch through a com-

munications system quite different from the monopoly prevailing when they were filled with "natives" who'd never heard of one another.

Privilege surrender and class peace.

In these pages we are speaking both to those living through the sundown of their class—at least to that sane minority we imagine among them, groping for graceful ways to surrender their privileges—and to those classes experiencing a political and cultural dawn. It is interesting that "the wood of the poor," as bamboo is known in India, is also the most perennial pet plant of the rich man's garden in the Orient. Classes at odds over other issues are united in their admiration of its practicality and charm. Perhaps a similar metapolitical alliance will emerge among radical conservationists of the West, as more people realize that bamboo is a green piece of planet bulging with more wonders than Aladdin's lamp, equipped to provide people a multitude of things, while acting on the wounded landscape as a mending salve. It is one of the largest and oldest devices of the earth to place more rapid order in that thin green film, one millionth its total bulk, that wherever not gashed by human intrusion is the healthy, breathing skin of a sensitive planet, the soil.

PLANT THERAPY

It is trumpeted as a triumph of contemporary agriculture in the United States that 3 percent of the

population produces the food for all the rest. Many hidden hours of hidden hands elude these statistics—deckhands and truckers coaxing oil from Arabia to Omaha tractors—but even if true, is it a desirable condition? If 3 percent of the people raise all the food, 97 percent are alienated from the soil and water and sun and subtle planet processes that hold us here. More and more people have been raised since childhood in a historically unprecedented dimension of exile from the earth itself, an exile celebrated as a blessed exodus from the bad land of toil. Contemporary with this exile, unprecedented destruction of forests, loss of topsoil, extinction of species, and elimination of native peoples have occurred. In the midst of this official mechanical madness—in which each bushel of corn is costing five bushels of eroded topsoil, each bushel of wheat, twenty—here and there is a quiet voice, a dirtied hand raised for an intimate agriculture, regional self-sufficiency, each of us once more a skillful and intimate *amigo* of the ways of plants and animals.

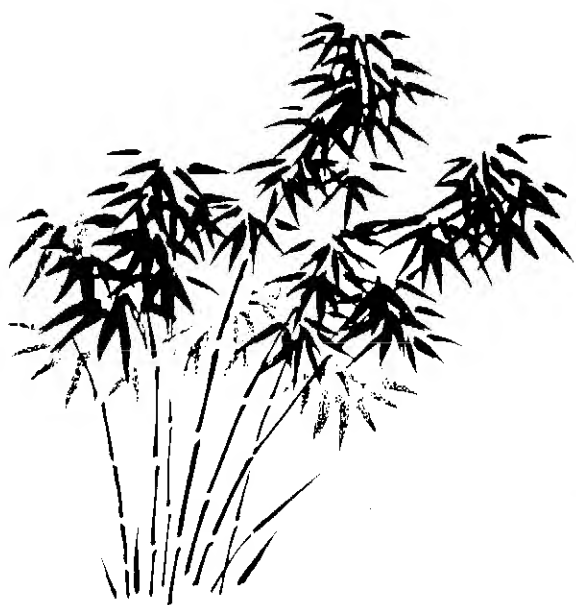
Hug your local oak.

Plants heal people. Living with them is a most beneficial therapy, and their unprecedented absence from our present urban designs may have more to do with the neurosis of our times than we imagine. Bismarck's physician urged him to hug an oak a half hour each afternoon as antidote to all the strains of his iron office. In order to practice this therapy, many harried Americans would have to board a bus to reach the nearest tree and wait in line to embrace it. In this cultural context, bamboo is suggested as one of the easiest of all plants to cultivate and love and among the most rapid to regreen the globe.

Leaf/people ratio: the bamboo scab.

Revegetation is critical for earth health as well as human sanity. An insane dimension of devegetation as prologue to a ruinous agriculture has lost, according to some estimates, one-third of U.S. topsoil in fifty years of industrialized and chemical agribusiness. This reckless loss of limited topsoil has complex consequences that are coming at us quickly from our increasingly fragile future. In modern cities, the leaf/people ratio is the lowest in history.

Leaves are therapeutic principally because they pump oxygen, the reduction of which in brain cells has been clinically found to increase anxiety and the whole spectrum of negative emotions that compose the familiar attitude configuration of hurried urbanites. Urban bamboo can not only pro-





duce building material on location to grow your loft or trellis or fence in your yard, it also spreads more square meters of leaves more rapidly, perhaps, than any plant alive. This airy green filter and a dense underground life renowned for erosion control combine to make bamboo a healing force for soil as well as soul. As scabs on skin, bamboo acts on earth to regreen spaces gouged by humans. It has traditionally repopulated forested areas cleared of their main timber crop or fields no longer actively farmed and is presently refoliating Vietnam in the wake of U.S. defoliation efforts during the war.³

Revegetation.

The per-person reserves of wood in the world are dipping drastically. Only in China and South Korea are reforestation efforts outstripping use. Since China has doubled her trees since 1949, we must conclude it isn't mere human numbers denuding our forests so much as uninstructed numbers not committed to a sane forestry policy—and a busy handful firmly committed to destructive greed. In the context of an urgent need for revegetation in many areas of the world, bamboo can take the weight off wood in a number of human uses, while playing the same roles as trees in modifying weather, controlling floods, diminishing winds, and guarding the soil.

BEGINNER'S BAMBOO: ESPECIALLY FOR GENERALISTS

In the beginner's mind, there are many possibilities, but in the expert's there are few.
—Suzuki Roshi, *ZEN MIND, BEGINNER'S MIND*

Specialization, and a consequent fragmentation of culture, plagues industrial societies. Monocrop

mentality in modern agriculture is mirrored in modern lives, shrunk generally to the sad dimensions of a "career," a two-syllable job. In *Education Automation*, Buckminster Fuller analyzes the history of the shift in U.S. higher education from a wholistic schooling of generalists to the training of experts who knew more about less and were well conditioned to trade their deep but narrow wisdom for a wage.

They were given the choice: king or messenger?
Everyone chose to be messenger, running about
with messages become meaningless, because
there were no kings.

—Franz Kafka, *PARABLES*

The tycoons of nineteenth century U.S. capitalism, the industrial pirates Fuller calls them, treasured the global overview that was the base of their power. They needed more and more well-trained, technological lackeys, and they did not need competition from generalists with a comprehensive grasp of how the empire was put together; hence the design of higher education in the United States, which they funded. The U.S. Naval Academy, before the introduction of radio aboard ships, was the only place deliberately training generalists, needed to assume intelligent direction of ships isolated at sea for long periods, able to shift decisions without consulting headquarters. But radio permitted the captain of each ship to be integrated in a command system directed from far away and far above. The U.S. Naval Academy immediately redesigned itself to train specialists.

The global schoolhouse and the global grove.
Whatever the cause of hyperspecialization in our

schools, bamboo is an interesting antidote, a prime piece of unassigned homework in Western education that could unite many directions of research, provide raw material for many forms of teaching aids and crafts, and landscape the campus. Hints for introducing bamboo at all levels of our schools as a subject to talk about and a source of projects to do are scattered through this text. We are particularly anxious to address teachers, help them reflect on the possibilities of bamboo use in their particular climate and cultural context. Schools too northern for outdoor cultivation might find constructing a greenhouse with a bamboo polyhedra frame a useful project to create garden space.

Locke, the British philosopher, in his "Essay Concerning Human Understanding," confesses himself among those rambling, unbloody hunters who prefer to start game to shooting it. In like spirit, we content ourselves here with disclosing a dozen directions rather than carefully mapping one. Inspirations rather than ready-made curriculums are intended. Occasionally, detailed descriptions for building a bamboo hen house or laying bamboo pipe are included to suggest the content of a more practical and explicit how-to bamboo.

BAMBOOPHILIA

The bamboo pioneers in the United States—David Fairchild, I. A. McIlhenny, F. A. McClure—were characteristically generalists, interested in all things human in all parts of the world, and finding in bamboo a specialization for generalists. The diversity of bamboo use, its global distribution, and the antiquity of its wedding with human will are features of the plant that make students of it residents of a rippling circle whose center is everywhere and circumference nowhere, as some Western theologian once defined God. So studying bamboo makes one a beginner for life, which may account for the longevity of many of its most famous lovers.

Lovers and venders.

This perennial freshness is more amplified for us because bamboo itself is at a point of new beginning in the West, with directions of development as yet unknown. That is part of its excitement. A field as yet unfenced by experts, a virgin grove, is all the more open to amateurs—a word whose root meaning lies in the Latin word for "love." Amateurs are always useful reminders to the sober specialist that affection is the sharpest lens, and that the most nimble scientist shares the passion of the true philosopher, who is not the husband, warden, vender,

barker, or press secretary of wisdom, but merely her lover—a mobile and wonderful uncertainty rather than a frozen role.

Planet poultice.

A culture doctor, prescribing healing motions for the rheumatic West, could do worse than bamboo as a totem plant and poultice for our social pains—not least of which is a marked decline in love of life and of our kind, our human kin. Bamboo enjoys a widespread and persistent history as an aphrodisiac, reputedly giving more bounce per ounce than anything but a rhinoceros horn, which the rhizome of one species in India resembles so closely that it has stimulated a fraudulent black market of love in which only an expert (pardon the word) can distinguish the real rhino from the rhizome.

Handsome history now.

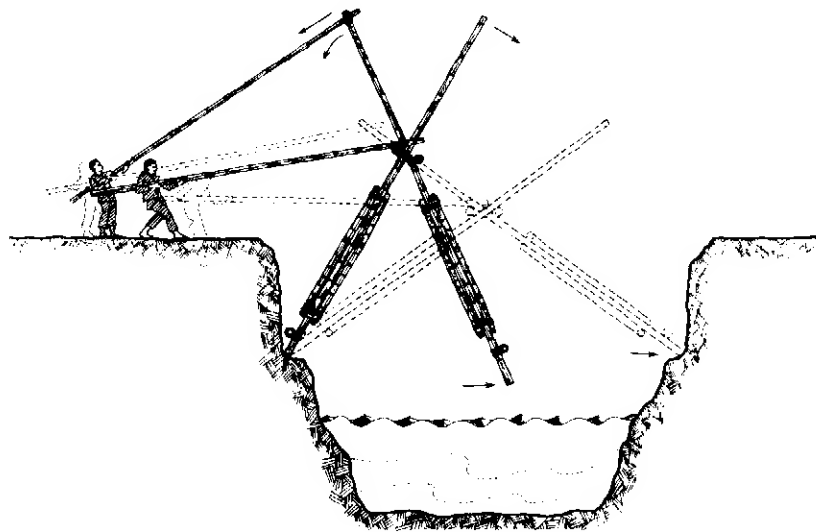
Maybe more intimate acquaintance with bamboo traditions can foster keener lovers of history, the total spoor of our species, as well as lovers of the poor planet beneath history where the trash of error lands. The truest history, for us, is the one we are making. Bamboo's vitality may inspire us to make more handsome history now, with a little help from our mutual friends.

THE KING OF CHINA AND THE CLEVER CHILD

Once upon a Zen fairy tale, the King of China called his three sons out back to the bamboo groves and said, "Before I die, I want to leave my throne to my wisest child. Tell me, please, what is the best thing in the kingdom?" The first son praised the country's natural wonders and abundance, its noble mountains and its blooming plains. The second spoke eloquently and at length of what the human hand had heaped on the land—the roads and bridges, the temples and glistening palaces. "The best thing in the kingdom," said the third, "is my own mind—for with this I judge the value of the rest."

Questing roots.

The best resource of nature in the plastic and polluted kingdom of our days is that naughty human intelligence clever enough to make a rapid mess of our planet, using—according to ancient masters and contemporary psychologists—only some 2 percent of the computers tucked between our ears. That leaves 98 percent as yet untapped to clean up the trash. It obviously isn't intelligence but clear will and agreements to learn that are lacking, a generous



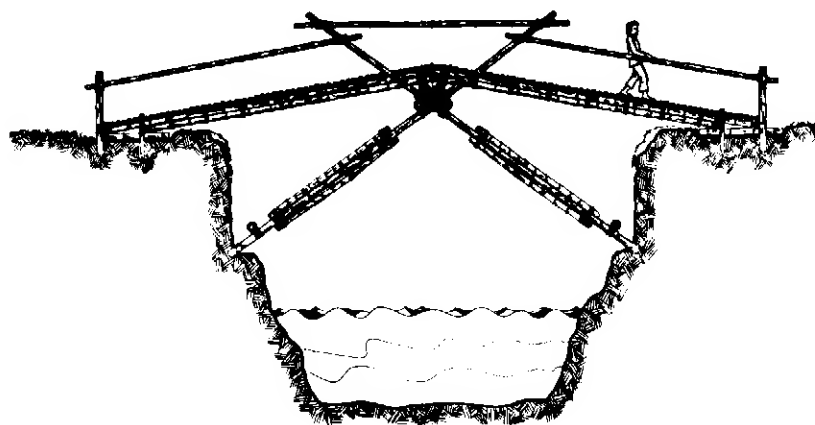
leap into a zone unfrequented by the specialized mind: thinking with the heart, learning to live and let live with our whole equipment.

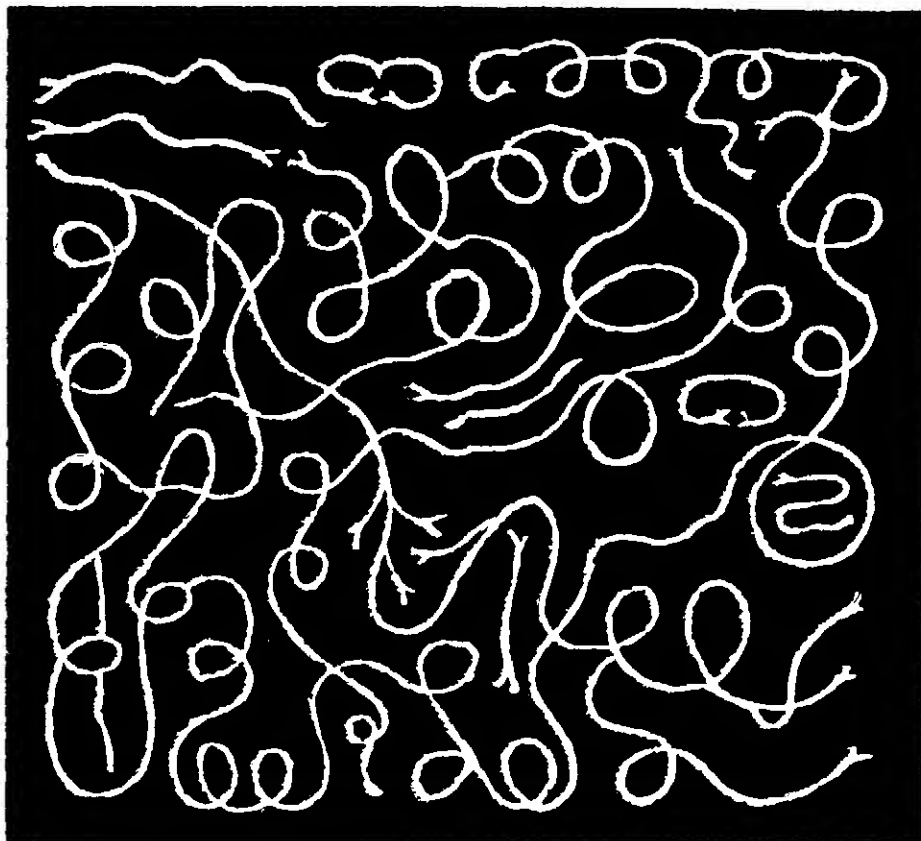
The world's two greatest underdeveloped resources are the human capacities for creative fulfillment, which are thwarted by hunger, poverty, disease, violence, and lack of education; and the mineral rich subsoils which can most efficiently be utilized by the powerful, questing roots of trees and other perennial plants.⁴

Bamboo bridges: appropriate travel and learning to learn.

The more rapid the changes around us, the more we learn that life is about learning. The Way is an ease in process, not a fixed goal. Western people,

especially, have to replace dominion with dance—in schools, in agriculture, in family and foreign relations. Bamboo, ancient and adroit changer, has been riding climates roughly 200 million years now, about four hundred times the life of our species. Perhaps it can help us really wake to our limited mornings, to flourish as durably. Bamboo's diverse use is what most makes of it a maximal learning zone, a point where many interests overlap. Admiration for its virtues unites scientists and musicians, farmers and architects, craftspeople and artists, rich and poor, country and city, East and West. Ancient builder of many bridges, bamboo can also serve as a thin union between peoples of North and Central-South America, where we need, at this dangerous and fragmented moment of a dwindling century, all the bridges we can find or build.





Map of the Tao, northern Sung dynasty.

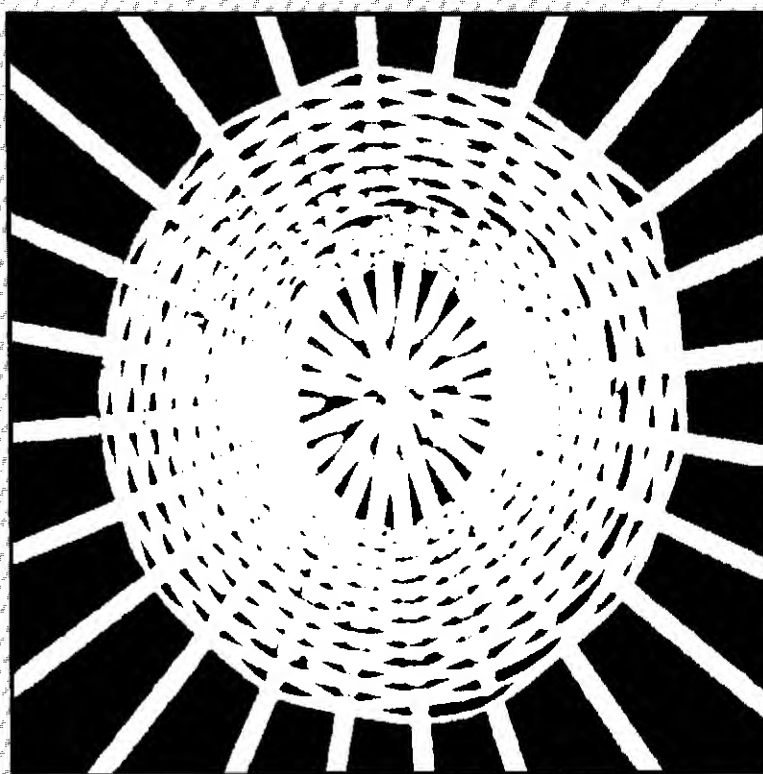
Beware of bamboo.

In no way feel obligated to plod forward in these pages chapter by chapter to the end. Dip, skim, skip—enter this grove at any point, proceed in any direction. But be careful: Beware of bamboo. It is emotionally invasive. This book may begin a muddy adventure dragging you far from the safe shop where you purchase it and the home where you peruse it.

Go . . . not knowing where. Bring . . . not knowing what. The path is long, the way unknown. None know how to arrive by themselves alone. We must seek help and guidance from more complete forces.
—Russian fairy tale

CHAPTER 1.

1. Ueda 1960; Varmah 1980 notes a sudden but still inadequate upswing in oriental bamboo research around 1975.
2. *Abend im abendland*.
3. Drew 1974.
4. Douglas 1976, via deMoll 1978:96.



2. ONE THOUSAND
THINGS

"One of the most thorough investigations of the uses of bamboo, by Hans Sporry [1903], lists 1,048 uses, from Japan only, of articles in his own collection. Another 498 ornamental uses brings the total to 1,546. These uses, with variations, would stand almost as they are for China as well. One cannot live long in a country where bamboos grow and are used by the people without feeling that bamboo has contributed a great deal to their progress, and that the mastery of its uses marks a cultural stage in the development of their civilizations. Archeologists would indeed be justified to incorporate, in their historical outlines for tropical and subtropical Asia, a definite Bamboo Age comparable with that of Stone or Bronze.

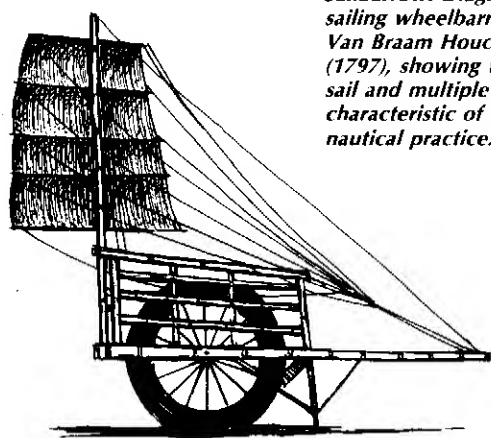
*"It is no wonder that native craftsmen soon found such a workable material a broad field for cultivating their genius. Because of its great tensile strength, its capacity for splitting straight, its hardness, its peculiar cross-section, and the ease with which it can be grown—a combination of useful traits found together in no other plant—bamboo is one of those providential developments in nature which, like the horse, the cow, wheat and cotton, have been indirectly responsible for man's own evolution."*¹

HANDY MAGIC: BAMBOO APPROPRIATE TECHNOLOGY

Among the most useless uses of bamboo recorded, the Everest of irrelevance is that embodied in an observation of one Osbeck who published an account of his voyage to China in 1771: "Laborers are obliged to pare their nails, but people of quality let them grow as long as they will, keep them very clean and transparent, and at night put little cases of bamboo on them. Very long nails are a token of elegance, and shew that the wearers are arrived at a thorough pitch of genteel helplessness."

This tiny monument to the antihandy can stand

as a perfect counterpart to the sane resourcefulness that has characterized bamboo use for millennia wherever its abundance has provided people a prolonged chance to explore alliance with the plant. Technologically, bamboo is "rampantly invasive"—as some of the species are called in nursery catalogs. If bamboo is broadly available in a culture for an extended time, its cheerful readiness to service human need creeps into people's lives at every crack and cranny . . . and seeps deeply into their affections as well. There is almost nothing that the Chinese, in particular, have not fashioned from bamboo in the course of the lengthy evolution of their technology, which Joseph Needham docu-



Sailbarrow. Diagram of a sailing wheelbarrow from Van Braam Houckgeest (1797), showing the batten sail and multiple sheets characteristic of Chinese nautical practice.

ments in his huge witness to Chinese ingenuity and British scholarship, *Science and Civilization in China*.

Springs for mechanical toys and automata were made from bamboo laths, which served also for crossbows, door closers, and animal traps. Bamboo brine buckets 75 feet long with a 3-inch diameter lifted 28 gallons each as much as 2,000 feet up from the Szechuan salt fields to bamboo pipelines sealed with a mixture of tung oil and lime.² Bamboo water guns were used for fire fighting in the eleventh century,³ at which time plybamboo was also employed for the vanes of a rotary-fan winnowing machine.⁴ Bamboo and oak served as teeth in baked clay grain mills around 200 B.C.⁵ Bamboo wheelbarrows tripled weights workmen could carry, even on mountain paths, "winding as the bowels of sheep."⁶ Sometimes the wheelbarrows were equipped with bamboo sails, with a loading capacity of 365 pounds.⁷

A bamboo well sweep with a counterweight at one end and a bamboo pole at the other was an early and simple method of lifting water.⁸ Waterwheels with bamboo cups were also common, the largest wheels being 60–75 feet in diameter.⁹ Windmills with bamboo mat-and-batten sails were used for irrigation.¹⁰ In rural Taiwan, bamboo-piped wells up to a depth of 150 meters (492 feet) are still common.¹¹

A list of bamboo things, such as the very incomplete one that follows, suggests specific uses we can imitate directly or adapt—an idea bank for bamboo crafts and constructions. But the gradually amplified and modified uses of bamboo in different places and new times also indicates that its uses are virtually endless and still to be explored. Modern methods of chemical analysis, for example, have only recently pried into some secrets of the culm.

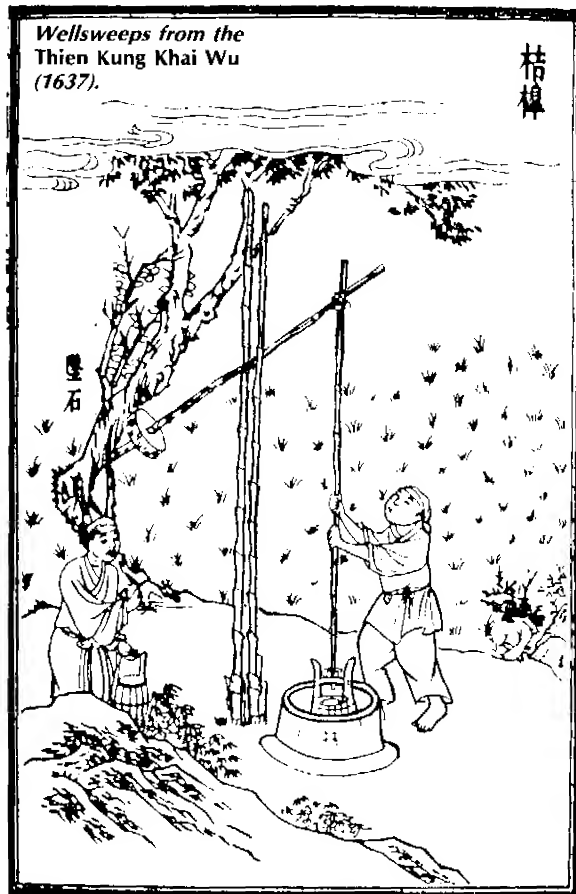
New uses for bamboo products have been developed, and new significance found in old uses. Tabasheer, found within the culm internodes of many tropical bamboos, consists almost entirely of amorphous silica in a microscopically fine-grained state; it has excellent properties as a catalyst for certain chemical reactions. From the white powder abundantly produced on the outer surface of young culms of a Chinese bamboo, many substances have been isolated, among these being a crystalline compound related in chemical composition to the female sex hormone. Liquid diesel fuel has been prepared from bamboo culms by distillation.¹²

PLANETARY NORM: THE MODERN VILLAGE

Wanting more than your share is not good ecological logic. Immanuel Kant made up a long boring name for a simple but ample idea. He called it the "categorical imperative," which meant you were to test the ethical value of any questionable act by asking: If everyone always everywhere acted as I am now acting here, would the world work? Is my style of life, my total routine of giving and taking, using and making, a possible planetary norm?

It's worth reflecting on bamboo in the context of an awakening world interest in appropriate technology¹³—a recent phrase for the old reality of creatively making do with the locally available and cheap instead of importing distant and dear solutions made elsewhere and alien to the context at hand. A sad irony in many developing countries in the process of decolonization is a schizophrenic attitude toward the dominant U.S. or European culture. Although rejecting a destiny in the dark shadow of a superpower, they are often ready to rush headlong after the disastrous lead of hyperindustrialization with its attendant pollution, its erosion of land, consciousness, and social values—all the double-ugly urban wasteland that lies in wait at the end of the freeway, still hidden behind the high horizons of their hopes. Many Third World nations, while rejecting the role of colony to the United States or to other foreign purposes, echo the tragic wish to treat the earth as though it were a colony of human will.

Current metal consumption can be cited, as one example among many, to demonstrate that present levels of use are not a feasible future for the United States or anyone else wishing to imitate this gaudy style. In the past sixty years, people have taken more metal from the earth than had been mined in the previous 6 million years.¹⁴ But, "to raise all the 3.6 billion people of the world to the 'American standard of living' would require:

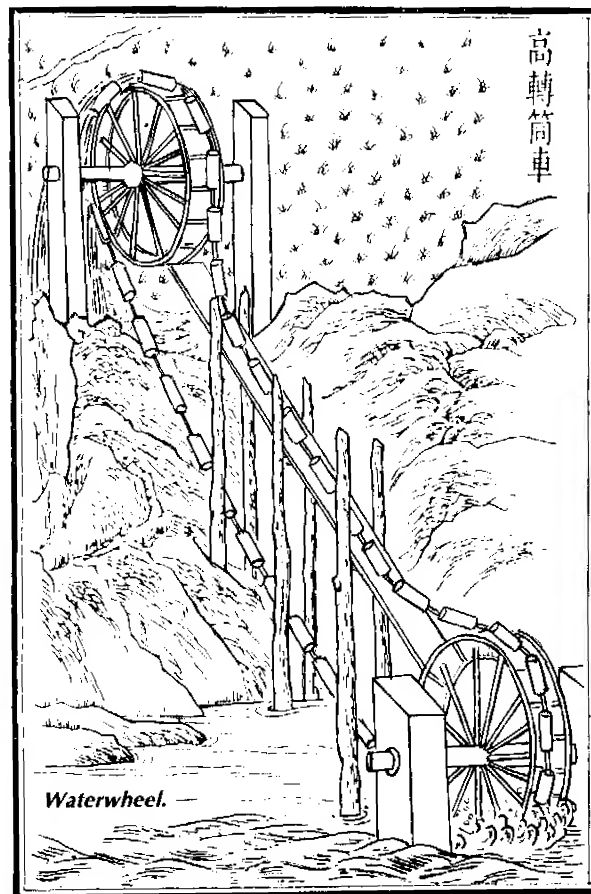


75 times as much iron, 100 times as much copper, 200 times as much lead, 75 times as much zinc, 250 times as much tin as is now extracted annually."¹⁵

The greater the imbalance of the metal and oil resource distribution, the greater the constant expense of more metal and oil to defend the embattled castle. The United States is a pseudo-Eden under siege. Nearly 85 percent of humanity lives outside the shiny garden. We are acting out an unreal fairy tale. A possible norm must replace the glittering exception as the objective of the great cultural quest. There isn't enough glass, there aren't enough coaches, for everyone to get the shoes and ride of Cinderella. There could be, easily, enough bamboo. For a thousand things, for 6 billion people; it is a feasible planetary norm.

Migration to margins: a sane response to urban sprawl.

A number of recent books help demonstrate that the increases in energy consumption of industrial societies cannot continue. *Soft Energy Paths* (Amory Lovins 1977) and *Rays of Hope: Transition to a Post-Petroleum World* (Denis Hayes 1977) are two that deserve mention. A cofunction of "hard



energy paths" is the ever greater centralization and "implosion" that is a chief feature of our urban times. Ironically, greater physical densities seem to increase social fragmentation and a drastic decline in human intimacy. The closer our bodies are jammed together, the more our spirits and families fall apart. The hope of appropriate technologists is that small technologies can help halt the great migration to towns by making the modern village viable as a way of life, enriched, not destroyed, by a development scaled to local need and resource. Bamboo's ample possible role in this decentralization is hinted at by the brief examination in this chapter of some pieces of its past.

APPROPRIATE BAMBOO CATALOG

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A A-frame houses,
activated charcoal,
acupuncture needles,
airplane wing
members and stress
skin for fuselage,
alarms,
alcohol,
anchors,</p> | <p>angklong,
antenna supports (TV
and radio),
aphrodisiac,
arbors,
arrows and arrow tips,
ashtrays,
awnings.</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|

Bamboo ubiquity

European travelers in the late nineteenth century compiled astonished lists of the daily uses of bamboo in China and Japan before the advent of extensive Western influence. A. B. Freeman-Mitford's *The Bamboo Garden* is a fair sample of Western amazement in the face of so varied a use of a single resource, a remarkable cultural phenomenon without counterpart in European traditions. "To the Chinaman, as to the Japanese, the bamboo is of supreme value; indeed, it may be said that there is not a necessity, a luxury, or a pleasure of his daily life to which it does not minister. It furnishes the framework of his house, and thatches the roof over his head, while it supplies paper for his windows, awnings for his sheds, and blinds for his veranda. His beds, tables, his chairs, his cupboards, his thousand and one small articles of furniture are made of it. Shavings and shreds of bamboo are used to stuff his pillows and mattresses. The retail dealer's measures, the carpenter's rule, the farmer's waterwheel and irrigation pipes, cages for birds, crickets, and other pets, vessels of all kinds, from the richly lacquered flower stands of the well-to-do gentleman down to the humblest utensils of the very poor all come from the same source.

"The boatman's raft and the pole with

which he punts it along, his ropes, his mat-sails, and the ribs to which they are fastened, the palanquin in which the stately mandarin is borne to his office, the bride to her wedding, the coffin to the grave; the cruel instruments of the executioner, the lazy painted beauty's fan and parasol, the soldier's spear, quiver and arrows, the scribe's pen, the student's book, the artist's brush and the favorite study for his sketch; the musician's flute, mouth-organ, plectrum, and a dozen various instruments of strange shapes and still stranger sounds—in the making of all these, the bamboo is a first necessity. Plaiting and wicker-work of all kinds, from the coarsest baskets and matting down to the delicate filigree with which porcelain cups are encased, are a common and obvious use of the fibre. The same material made into great hats like inverted baskets protects the coolie from the sun, while the laborers in the rice fields go about looking like animated haystacks in waterproof coats made of the dried leaves of bamboo sewn together. See at the corner of the street a fortune teller attracting a crowd around him as he tells the future by the aid of slips of bamboo graven with mysterious characters and shaken up in a bamboo cup, and every man around him smoking a bamboo pipe."

ACUPUNCTURE NEEDLES. These were supposedly originally made from bamboo. The role of bamboo in cultural acupuncture, the art of producing maximal response through minimal force strategically applied at key points, is the meditation of these pages.

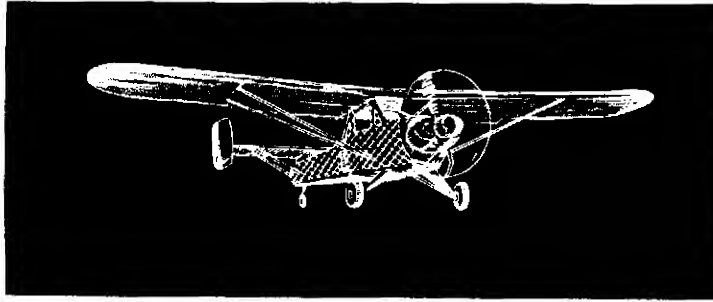
AIRPLANE SKINS. "The remarkable tensile strength of bamboo was not fully realized until recent times, when experiments were made by the Chinese Airforce Research Organization at Chengtu; it was found then that plybamboo of formidable qualities could be made by uniting layers of woven laths with aeroplane glue . . . But all through the centuries this property had been empirically utilized to the full in bamboo cables and ropes for many purposes."¹⁶

Woven bamboo panels were used in the Philippines during the 1950s as an experimental low-cost covering for wings and fuselage of light airplanes by the Institute of Science and Technology in Manila. *Bambusa spinosa* and *Bambusa vulgaris*, with thin walls and long internodes, were cut and seasoned in the dry months (December–May), then split into strips 1 cm wide by .6–1.2 cm thick. The inner and outermost portions of the culm wall were discarded: the inside as too weak, the skin as too slippery and hard to glue. Submerged in salt water

48–60 hours as a preservative against insects, washed in clear water, and dried, the strips were woven—at 45-degree angles to one another—in panels 2 m by .5 m. *Sawale*, a type of weave used for walls in the Philippines, was chosen. Panels were given a coat of glue liquid enough to soak well into the weave and another coat of glue mixed with fine soft-wood sawdust to even the surface, which was then sanded. Performance was good, and three years after construction the skin showed no sign of deterioration in spite of severe weather conditions.

Low in cost, requiring no complex machinery or construction techniques, bamboo was highly recommended by the experimenters as also useful for waterplanes and the landing apparatus of light planes because of its ability to absorb shock. A detailed report and tables comparing bamboo quite favorably with other materials used for conventional airplane skins is available in Hidalgo.¹⁷

ANGKLUNG. "The angklung of the Malays is a very agreeable instrument. It consists of a number of hollow bamboo joints of various but selected lengths and thickness which are cut out below and hang down from a bamboo frame. These give various swinging tones and strength according to their



Woven bamboo airplane skin, Philippines, 1947.

size on being beaten with a bamboo staff."¹⁸ (See *musical instruments*.)

APHRODISIAC. Bamboo makes the heart beat fonder—at least an old tradition has it that lovers can be more loving with treatments of tabasheer (see under *T*). But the plant probably earns its most handsome price per pound in a fraudulent traffic described by Varmah: "The rhizome of *Dendrocalamus hamiltonii* with slight trimming and dressing, is an exact replica of a rhinoceros horn which fetches a fabulous price as an aphrodisiac. Only an expert perhaps can identify the imitation rhino horn from the real."¹⁹

ARROWS. In Japan, *Pseudosasa japonica* is known as *metake* or "arrow bamboo" for the shafts made from its branches. A very common ornamental, it was perhaps the earliest hardy oriental bamboo introduced into the United States around 1860,²⁰ and groves are widely available for those who have a strung but empty bow. Above all, arrows must be straight and light, so the wood of many bamboos can be made to shape them. In the Zen tradition archery is a mirror of the soul, its practice a physical discipline that hones the mind: "You are the target . . . if the archer misses the mark, he looks for the error *inside*." *Zen in the Art of Archery* is a well-known account of a German, Eugen Herrigel, studying under a Japanese master:

"The right art," cried the master, "is purposeless, aimless! The more you try to learn how to shoot for the sake of hitting the goal, the less you will succeed . . . You have a much too willful will. You think that what you do not do yourself does not happen . . . We master archers say: with the upper end of the bow the archer pierces the sky; on the lower end, as though attached to a thread, hangs the earth. If the shot is loosed with a jerk there is danger of the thread snapping. For the purposeful and violent people, the rift becomes final, and they are left in the awful center between heaven and earth."

"What must I do then?" I asked thoughtfully.

"You must learn to wait properly."

"And how does one do that?"

"By letting go of yourself, leaving yourself and everything yours behind you so decisively that nothing more is left to you but a purposeless tension."

Austin (136–43) provides twenty-three photographs on Japanese manufacture of bamboo bows and arrows. The lamination of wood and bamboo in the bow may be the oldest surviving use of this important modern industrial practice.

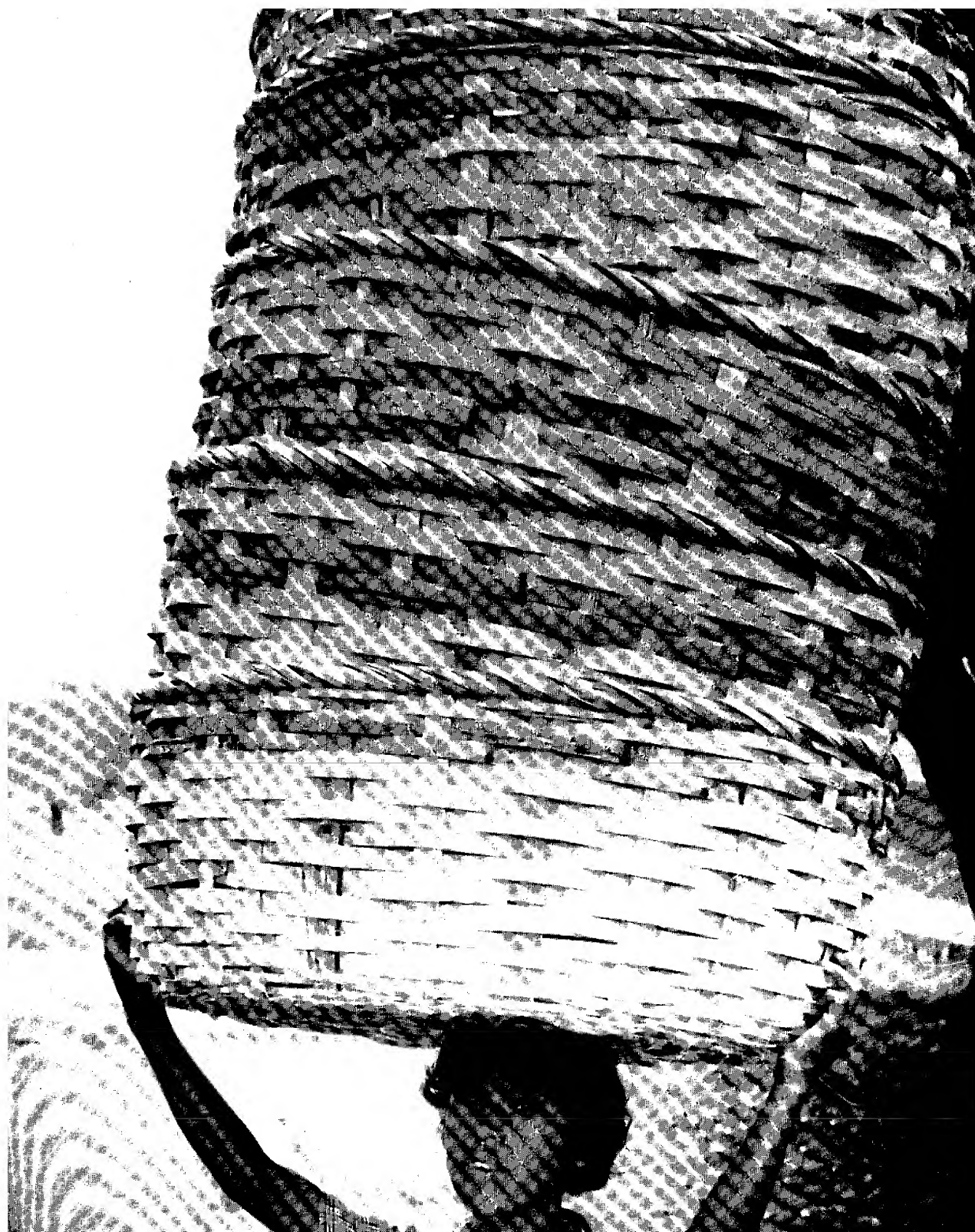
B	Baby carriages,	bolts,
	bagpipes,	bookcases,
	barrels,	books,
	baskets,	booms,
	beads,	bottles,
	beanpoles,	bowls,
	beds,	bows (archery),
	beehives,	boxes,
	beer,	bracelets,
	bikes,	bridges,
	bilge pumps,	brooms,
	blinds,	brushes,
	blowguns and darts,	brush pots (washers,
	boards,	and rests),
	boat hoods,	buckets,
	boats,	buttons.

Baskets: a bamboo boot camp.

Any design for development of bamboo as a resource in Western cultures will quickly bump up against baskets and mats and their makers. Basket-making and weaving skills are the basis of ancient 10 by 30 foot rolls of walls delivered by oxcart to house sites in a number of oriental countries, a main component of Eastern shelter.

Basketry is also basic in lacquerware (q.v.), and in the modern manufacture of plybamboo in all forms, from building panels to laminated salad bowls and plates.

Basketmakers represent the main bamboo work force in many areas of bamboo use. Future development will start in their villages and should



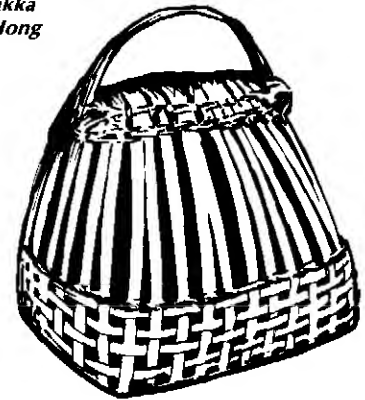
be aware of the sociology of basketmakers. They tend to work in family groups, with children eased early (around 8) into the errand. Basketmakers are usually badly paid and poor. For some, drinking seems an occupational hazard. They harvest their raw material and often market their own goods, so they experience a spectrum of natural and social realities which many professions fail to roam. Working at home, at their own chosen pace and hours, at tasks possible for children to join, there is a wonderful overlap of family and workspace possible among those practising the art. Men and women, young and old join in the work, though heavier aspects of it—harvest transport, splitting large culms or weaving big cumbersome market baskets—are usually reserved for men and older boys. Basketmaking families are geared to sprints of production at crisis times, seasons of the year which require for some harvest or some fiesta a sudden rush of work. They also have that independent spirit of being their own boss, a life mood shared with all artisans; circus families; cab drivers in the modern urban scene—all those who earn their living unwatched by employer's eye.

Basket- and mat-makers as a work class represent the largest body of teachers available in any culture to introduce people new to bamboo to its basic handling from grove to market. A basket village with a large number of families involved in the craft is a ready-made school, a bamboo boot camp for those wishing to combine what you can find out from the books with what you can find out from the baskets and from the fields, from the fiber and the people splitting it.

BASKETS. China, Philippines, Japan. "Since earliest times, baskets have occupied a prominent position in Chinese civilization. In the *Book of Songs* and the ancient *Rituals*, many terms for various kinds of baskets occur. We read of round baskets of bamboo, of square shallow baskets of bamboo or straw . . . The young bride offered fruit in a basket to her father-in-law, and since men and women should not touch hands, the woman should receive gifts in a basket. . . . Baskets in funeral ceremonies were placed near the coffin filled with cereals for the departed soul, a custom still of farmers around Peking, who bury their dead with an oval basket of willow twigs, which serves as a grain measure in ordinary life.

"We also hear of industrial baskets . . . fish traps set at openings of dams; and in the silk industry, the main occupation of women, the tender

Cock cage from a Hakka village in Kowloon, Hong Kong, 20th century.



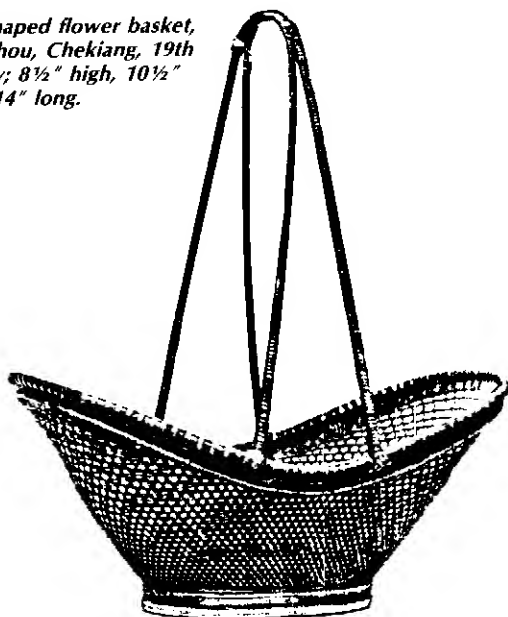
leaves of mulberry on which the silkworm feeds were gathered in deep baskets, and a square basket served for depositing the cocoons. Basket trays still play an important part in the rearing of silkworms.

"In northern China, baskets are part and parcel of the rural population. Plain, practical, strong, durable, they are used chiefly for agriculture: collecting and carrying earth and manure, winnowing, storing grain, transportation. . . . The home of the artistic basket is in the Yangtse Valley and south. Here we meet in full development the flower basket with a great variety of shapes and graceful handles, the picnic basket with padlock, the neat traveling basket in which women carry their articles of toilet, and the 'examination basket' in which candidates visiting the provincial capital for the civil service examinations enclosed their books and writing materials, as well as the cozy for tea-pots, more practical and efficient than our thermos-bottles, and the curious pillow of basketry weave. The basket boxes with raised and gilded relief ornaments are also characteristic of the south.

"Chinese genius developed baskets unknown in other countries. Basketry was combined with other materials like wood, metal, and lacquer. Its appearance was enlivened and embellished through processes originally foreign to the industry. Many basket covers display a finely polished, black lacquer surface on which landscapes or genre pictures are painted in red or gold. Others are decorated with metal fittings (of brass and white metal) finely chased or treated in open work. Delicate basketry is applied to the exterior of wooden boxes and chests, even to silver bowls and cups. In this association of techniques, Chinese basketry has taken a unique development which should be seriously studied by our own industrial art-workers."²¹

Porterfield lists thirty-two types of baskets on sale in Shanghai in 1925. Among them were water-

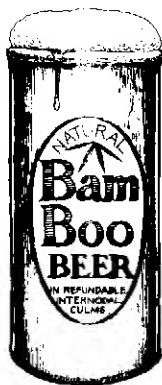
Boat-shaped flower basket, Wen-chou, Chekiang, 19th century; 8½" high, 10½" wide, 14" long.



bottle baskets, sandwich, wastepaper, fruit, gardener, cake, flower, travel, clothes, picnic, tea, food, market, egg, sewing, suitcase, washing baskets. Others were named for their shape: open-work square, closed-work square, boat shaped, basin, partitioned, round, oval, and cylindrical.²²

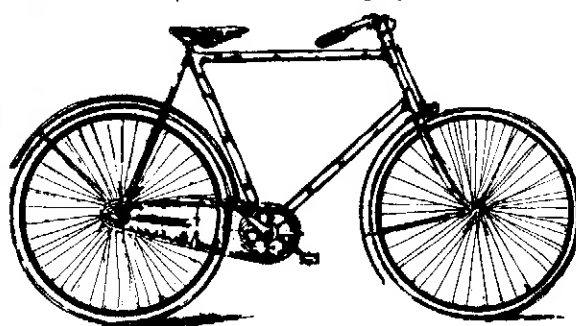
BEEHIVES. "Joints of the larger bamboos are also used for beehives. A closed bamboo joint or one cut in two and again tied together with strings is suspended horizontally under the roof of the house. A small hole made at one end enables the bee to enter."²³ *Dendrocalamus asper*, with an 8-inch basal diameter, is similarly used in Nicaragua. Any bamboo of ample diameter will do.

BEER. Bamboo beer is made from the dark, long-grained, ricelike seed of flowering culms of *Arundinaria hookeriana* in its native Sikkim. The species was named by Munro for its discoverer, J. D. Hooker, who reports this practice in his *Himalayan Journals*.²⁴



BIKES. Bike frames are basically a triangle of joined tubes with appendages used to meet and drive wheels. They were manufactured of bamboo in Europe in the late nineteenth century.²⁵ "It is not at all fanciful to point out that furniture, scaffoldings, and other erections of tubular steel make use at a more neotechnic level of exactly the same principles of structural strength as the ancient applications of the bamboo tube."²⁶

"The bicycle is a major mover of goods in the Third World. Loads can be tied directly to bicycles or placed in special frames, baskets, and trailers . . ."²⁷ "Pedal power" considers bikes from a perspective unfamiliar to most of us because the energy soup in which we swim in the United States rarely makes it necessary to generate our own. But as a power source as well as a vehicle, the bike is "in many respects the most efficient machine ever developed" on the earth.²⁸ The possible relation of bamboo bike frames, sidecars, trailers, and carrying baskets to Third World transport and pedal power is a research field as rich as it is fallow. China provides ample precedent for the wisdom of bike production as a way of both solving many problems of domestic transport while tooling up for heavier in-



Bamboo bike frames, manufactured in late 19th century Europe, make sense for mass transport in many developing countries today. China, with more

people to move about than any other nation, has found the bike to be the most energy-efficient method of doing it.

dustrial development. Pedal power makes even more ancient sense than black, red, yellow, and so on power because physics is older than species and race. With pedal power you can run pumps, mills, light bulbs, saws, and many other small-scale power tools. In many ways, the pedal could be whirling at the fertile center of the Modern Village, everyone riding seventeen minutes a day (kids thirty) to generate independence or reduced reliance on centralized energy sources, a fat spider with skinny legs. The U.N.'s Food and Agricultural Organization (FAO) says energy from thermal and

hydroelectric stations is sliced like most modern pies: 80 percent for urban industry, 10 percent for urban people, and 10 percent left for rural areas—88 percent “powerless” in poorer countries. This dark light bulb helps keep the down down in many ways. (See *windmills* for reflections on windbikes for decentralized irrigation.)

Forty years I've been using a kerosene lamp. The second of December last year I saw an electric light, which we never had before. When we here in Galilao saw light bulbs that don't blow out in the wind, we all hugged one another, and my brother started to cry.

—*La Barricada*, MANAGUA, NICARAGUA, 12 February 1983.

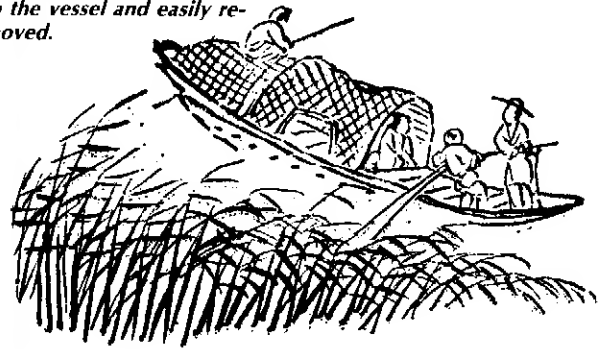
BLOWGUNS. Bamboo blowpipes or blowguns have existed a long time in many scattered locations on the earth. Known to the Iroquois, Muskogean, Cherokee, and other North and South American tribes, their use is perhaps most developed in Asia.

A Malayan species, *Bambusa wrayi*, has the greatest recorded internodal length among bamboos: from node to node measured 85.5 inches, making *B. wrayi* a natural choice for blowpipes in the area of its growth and helping to establish the reputation of Malayan blowguns as the best in the world.²⁹ “The Jacoons, or Treemen of the Malay Archipelago, shoot out poisoned arrows with such deadly aim that they even kill tigers with them.”³⁰ Blowpipes are a handy hunting device because they require no sophisticated tool bag to produce or repair. They are light to carry, made of a material locally abundant, shoot small and equally light darts often fashioned from the same plant, and are carried easily in ample numbers in quivers cut also from bamboo. Two hundred darts are packed for hunting trips by one South American tribe. Blowpipes are accurate up to 40 yards and since their silent flight does not disturb animals, a poor shot gets a second chance. With the proper eye and lungs behind them, the weapon displays amazing accuracy, penetration, and range: A British police officer in Malaya reports seeing native hunters bury darts 3 inches deep in deer at 100 yards. The Jivaro of Ecuador can hit a hummingbird at 50 yards—with the ultimate howitzer of blowpipes, a piece of bamboo 17 feet long.

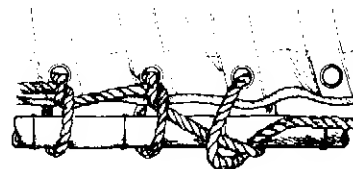
Blowpipe hunting skills were called upon as needed by many tribes in the Orient to defend themselves in wartime against invasion by hostile neighbors. The Subanon from the mountains of

Mindanao in the Philippines are a peaceful and gentle people who, without their poisoned darts and blowguns, might have been exterminated centuries ago by neighboring tribes addicted to the arts of war. The Dyaks of Malaya in World War II used 8-foot drilled wooden blowpipes against Japanese sentries with fatal efficiency in the Brunei area near the Palawan Islands. Curare, the poison used by South American Indians for darts, is supposedly a painless but infallible killer that affects the end plates between muscles and nerves, disconnecting them and consequently stopping the action of the heart and lungs. In a blowgun battle, there are no wounded—only living and dead. If you're hit, you get 15 minutes to regret you didn't know more about blowguns.³¹

Boat cabins of bamboo are lightweight, easily lashed to the vessel and easily removed.



BOATS. “Although bamboo generally is not fit for the construction of boats or canoes, Chr. Costa tells us of a sort of bamboo in the Moluccos (most probably *Gigantochloa maxima*), which produces such thick halms (culms), that the single joints split in halves are used for little canoes, in which two men are said to find place! For masts and spars of small native vessels bamboo is in general use. The outriggers of canoes peculiar to the Philippines and Ceylon are all of bamboo. . . . The other parts of a boat, such as cabins, etc., are usually constructed of bamboo on the same principle as houses.”³² (Cf. also *caulking, fishing, junks, rafts, and sails*.)



Booms are one of dozens of uses bamboo has aboard ship. Notice the method of tying the sail. Because of their light

weight, bamboo frames and booms are also useful for scenery in shoestring theater, especially for ambulant street players.



BRIDGES. Bamboo bridges of many designs abound in China and throughout the Orient. In western Yunnan, primitive bridges made of bamboo cables droop across gorges with one end fixed lower than the other. Bamboo tubes greased with yak butter slide down the cables, with a cradle hanging from them in which people and animals



Bamboo provided the fiber for the first suspension bridges, whose various designs combined whole culms, woven strips as warp to a woof of

branches or small diameter bamboos, and cables braided of workable species such as *Gigantochloa apus*, "string bamboo," a favorite for bridges in Java.

ride. The catenary suspension bridges of west China are also constructed of bamboo cables:

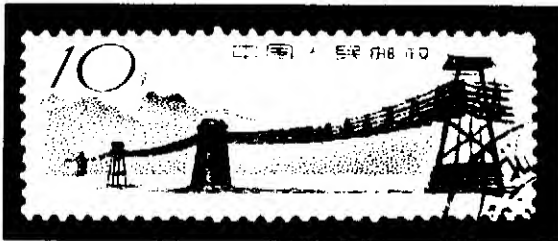
... made in the same way as those used for towing ships against the current of rivers, but of larger dimensions. Bamboo strips from the inner culm form a core in the center of the rope, and round them is woven a thick plaiting of bamboo strips taken from the outer silica-containing layers. The plaiting is so done that the outer portion grips the core the more tightly the higher the tension. Such ropes are generally about 2 inches thick, and three or more twisted together form one of the bridge cables. When placed in a testing machine, the straight inner strands break first, while the plaited material shows very great strength, not rupturing until a stress of 26,000 pounds per square inch is reached, though an ordinary 2-inch hemp rope can carry a stress of only about 8,000 pounds per square inch. Moreover, the silica-containing outer surface is very resistant to wear, e.g., against rock surfaces, which is naturally important both in towing and bridge cables.³³

(See *cables*, below.) A bamboo suspension bridge over the River Min, in Szechuan, the largest of its kind in the world, is described in E. H. Wilson's *A Naturalist in Western China*:

This remarkable structure is about 250 yards long, 9 feet wide, built entirely of bamboo cables resting on seven supports fixed equidistant in the bed of the stream, the central one only being of stone. The floor of the bridge rests across 10 bamboo cables, each 21 inches in circumference, made of bamboo culms, split and twisted together: five similar cables on each side form the rails. The cables are all fastened to huge capstans, embedded in masonry, which are revolved by means of spars and keep the cables taut. The floor of the bridge is of planking held down by a bamboo rope on either side. Lateral strands of bamboo keep the various cables in place, and wooden pegs driven through poles of hard wood assist in keeping the floor of the bridge in position. Not a single nail or piece of iron is used in the whole structure. Every year the cables supporting the floor are replaced by new ones, they themselves replacing the rails. This bridge is very picturesque in appearance, and a most ingenious engineering feat.³⁴

Bamboo cables were the earliest structural element in the history of engineering to be used for suspension bridges, which originated in western China and the Himalayas. Their antiquity is not precisely known: They are mentioned as early as A.D. 399 in Chinese literature by a Buddhist monk en route to India. Of great strength—a bamboo cable

A Chinese postage stamp honors the River Min bamboo bridge, design forerunner of many Western bridges.



of 2-inch diameter can support 4 tons—these ancient bridges spanned distances up to 76 meters without central supports. A number of different kinds of suspension bridges simpler than the complex style spanning the River Min—whose cables could be “tuned” like violins—are amply illustrated in Hidalgo (1974:151–71), who also includes some eight different designs for rigid bamboo bridges, derived partly from Indonesian designs, partly from the British military bridges in Asia. Hidalgo’s native Colombia and many other mountainous Latin countries that cannot afford the expense of conventional modern bridges would do well to reflect on traditional oriental designs. Kurz (223–4), in addition to describing briefly “bamboo bridges in general use all over India and Eastern Asia,” mentions the use, in Java, of floating bamboo bridges as well: “true pontoon-bridges are constructed on the same island, where the pontoons are substituted by strong bamboo rafts, which rise and fall with rise and fall of the river or of the tides.”

BRUSHES. The prevailing communications technology is a main shaper of all cultures. At the dawn of the East, from Jordan to China, we find the bamboo



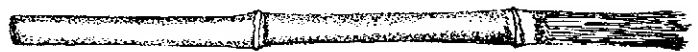
Chu, the modern Chinese ideogram for bamboo. Calligraphy is intimately bound to painting, in which the elimination of the inessential is a primary

rule. Here, six strokes—two culms and their attendant foliage—sum up the grove, in which each stalk can hold 80,000 leaves.

brush and the bamboo pen (q.v.). Bamboo exerted enormous impact on the duration of cultural memory as the earliest widespread writing technique in China, and the word for it roams widely through the Chinese language. (See *fishing*.)

Ideograms were supposedly invented in the time of the *Ku Wen* or *Ancient Learning*—around 2600 B.C.—by Ts’ang Chi, a minister with four eyes who was presumably doubly clever in consequence. Among the simple radicals, the 214 roots or bones used as an etymological alphabet to classify some 49,000 ideograms, a common one is *chu*, “bamboo,” a stylized but recognizable picture of two canes side by side, with strokes suggesting leaves and branches. As a radical, *chu* in turn forms part of a large number of ideograms. How deep and far *chu* has run through Chinese, how “invasive” the radical has been in the language, how many words share its strokes, would be interesting to know, and fairly easy for a native speaker to determine with a good dictionary.

The Chinese people value their past, and a large measure of their early affection for bamboo



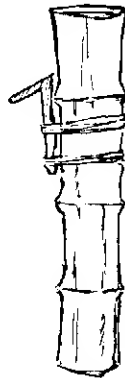
Brushes of bamboo, holding the fur of every imaginable animal, have been favored by Chinese artists for centuries. In a concession to ceremony, heavier, more ornate, and more expensive brush holders have been ritually presented and used, but the simple bamboo remains the pre-

ferred alternative. Sometimes, bamboo branches or thin culms are buried for several months, while microorganisms devour the starchy parenchyma tissue that holds the fiber in place; the brush and handle remain a seamless whole, as pictured here.

must derive from its help in preserving their traditions intact. Much of the history of Chinese custom and technology lies embedded in Chinese. Long after the solid things returned to their composing dust, the trace of them remained encased in ideograms through the fleeting and varied pressure of a bamboo brush flowing quick with ink and consciousness above thin strips of bamboo strung together like a fan. Some dug up in A.D. 281 had been buried 600 years or more—around 320 B.C.—and preserved details of Chinese history back to 2250 B.C.

For white-washing, Chinese masons use brushes made of thin bamboo slips fastened together and secured in a handle of bamboo. The Malay has similar ones, but beats with a mallet the whole end of a bamboo joint until dissolved into fibres

Bamboo water carrier. *The four nodes are easily knocked out for a cheap, lightweight, virtually unbreakable jug. Its surface per volume is small, which means less spillage on the trail.*



... The small brushes, used in China for coloring pictures, are also made of fine bamboo shavings introduced into a small holder of bamboo.³⁵

BUCKETS. "We do not ordinarily think of bamboo as a wood appropriate to the joiner's art. However, the making of the bamboo buckets and tubs used as containers for cooked rice is a trade in itself. Some thirty-odd tools, each with a special function, compose the kit of the maker of these bamboo vessels."³⁶

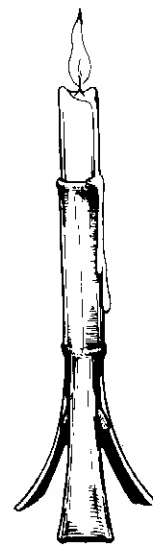
"Single joints of larger bamboos serve well for small water buckets. Thinner joints are cut just below the nodes, and the Indian obtains in this way little tubes, solid below, in which he keeps fluids, honey, sugar, salted fish, or fruit just as we do in bottles and jars. Many a Javanese can be seen on market days carrying home in this tube, suspended from bamboo string, the oil, etc., that he wants in his little household."³⁷

C Cables,
cages (bird, cricket,
tiger),
candlesticks,
canes,
canteens,
carts,
castanets,
catalyst (tabasheer),
caulking,
chairs,
charcoal,
chisels,
chopsticks,
churches,
cigarette holders,
clothes racks
(pins, and poles),
clubs,
colanders,

combs for hair and
hand looms,
cooking vessels,
coops for chickens
and ducks,
couches,
cow bells,
cradles,
crates,
cribs,
crosses,
crutches and
equipment for
handicapped,
cultures (for bacteria
in lab tests),
cups for drinking and
waterwheels,
curtains.

CABLES. "The historic travels of Marco Polo were among the first to reveal to the Western world the domestic value of bamboo. He tells how the Chinese manufactured cables for towing ships by first splitting canes their whole length into thin pieces and then by twisting these together into ropes three hundred paces long. It is interesting to note in passing that engineers experimenting for the Whangpoo Conservancy Board found twisted and plaited 4-inch ropes made with material taken from the outer eighth of an inch of bamboos being used to tow junks up against the current of the rapids in the gorges of the Yangtze River and estimated that the working stress was about 10,000 pounds per square inch of the material, this tension every now and then being doubled."³⁸ "On a journey up the Yangtze in 1908, Esterer made some measurements on the bamboo cables used by the junk haulers. He reckoned a tension of 7,362 pounds per square inch, of the same order as that normally taken by steel wires, yet the breakages were very few . . . Moreover, while hempen ropes lose some 25 percent of their strength when wet, the tensile strength of plaited bamboo cables increases about 20 percent when they are fully saturated with water."³⁹ Bamboo cables are available in lengths up to a quarter mile. As many as three hundred men may be tugging on them in the Yangtze rapids.

CANDLESTICKS. "Candlesticks are made of bamboo, superior to those empty bottles that European travelers often use. A node is left in the middle of a section of thin bamboo wide enough to receive a candle, with the portion below the node divided



*Grab the future in one hand,
in the other, the past;
sooner or later,
you'll have to put them down.
Shoulder wind and moon
on a bamboo pole—
you'll have to unload them
at last.*

—Tze-chiang 1959:25



into three. A stone wedged between these three furnishes a tripod candlestick."⁴⁰

CARRYING POLES. "Big bamboo poles are used for carrying heavy loads in China. In the cities one often hears the familiar antiphonal 'heigh-ho'ing, indicating that a heavy load is being moved somewhere. The heavier the load, the louder and more agonized the chant. The load is suspended by ropes from the middle, and the ends of the pole rest on the shoulders of two men. In the case of heavier loads, the ends of the primary pole may constitute the center loads of two secondary poles, the weight then being distributed between four men instead of two. The chanting helps the men keep time, a very important factor in transporting the load easily. They get into the swing and can take advantage of the recoil of the pole to make their steps forwards. In this way the load is always heaviest when the two men, taking the first case, have both feet on the ground and lightest when they are taking a step. On the same principle, towed boats always have the towline fastened to the top of a bamboo mast because of its springiness. It gives with the step of the pullers, yet at the same time exerts an almost constant pull on the boat. A split pole about five feet long, tapered except for a small knob at both ends, serves as a carrying apparatus for one man alone, a small load suspended from each end and the whole balanced on the shoulder."⁴¹

"The use of bamboo for pikolan (carrying poles) is general amongst Malays, and even children are fond of appending their load (and were it only a few plantains) to a bamboo stick for the purpose of "pikol" as this mode of carrying is generally called. The bamboo halms are very strong, and can resist loads of 100 to 200 and even more pounds, but if exposed too much to the sun are apt to crack on account of heating the air enclosed in their joints. Smaller pikolans are made of a shape somewhat like bows, flattened and the edges rounded, often more or less ornamentally carved

towards their ends. Loads of equal weight are fastened at both ends so as to keep the balance. When a Javanese has on one side only a load which he cannot divide, he appends as much weight (and were it only a stone) to the opposite end; so innate is custom in man. The carrying of such loads has its peculiarities, inasmuch as the carrier hastens in consonance with the elastic swingings of the bamboo, taking at the same time advantage of every swing that may lessen his burden. In this way he carries with less exertion a larger load than do the monotonously singing palkee bearers of Bengal, whose poles consist of unelastic wood."⁴²

CARTS. Many kinds are made wholly or partly of bamboo. "Bamboo is also fitted for yokes of cattle, axles and even springs of the smaller carts. In Java, etc., these carts have a sort of little bamboo house built upon them with a vestibulum in front, wherein the driver comfortably sits, and often falls asleep without knowing it."⁴³

The present planet importance of cart design can be brought home to a citizen of America only through prolonged residence in a rural area where oxen and other animals still carry or pull much of the load: "In India, it has been calculated that the total national investment in bullock carts exceeds the investment in either the national railroads or the national road network. The number of ton-miles of material moved is also comparable. (15–18 billion ton/km per year.)"⁴⁴

For short hauls, small loads, versatile movement over any available surface and low freight charges, the cart has no peer either in the rural areas, or, for that matter, in the towns and cities. It is still cheap, readily available, and safe. . . . [But the Indian] traditional cart is defective in design. The draught power of the animal is wasted due to friction resulting from rough bearings and crude and inefficient harnessing, etc. The wobbling rim cuts into the road surface and damages it . . . Weights run high. Traditional carts can be easily improved by: smooth bearings, lower weight, the introduction of a log-brake, better harnessing, the use of pneumatic tires on paved roads [hard rubber tires in rural areas].⁴⁵

This analysis applies as well to Latin America. In the Nicaraguan village where we sit agreeing with Ramaswamy's analysis (above), we have been watching nearly two years now the six ox carts of the pueblo do most of the heavy hauling. Ramaswamy notes that animals provide 66 percent of the

energy input in Indian agriculture; people, 23 percent; electricity and fossil fuels, 10 percent. This percentage reflects the reality in many countries, East and West.

CAULKING. Material for caulking is commonly made of shredded bamboo, prepared by scraping the culms, embedded in a putty of lime and tung oil.⁴⁶ So, bamboo is the crowning glory of junks (q.v.) in the battens of their sails—and the invisible, sine quo non caulking needful in the keel.

"The work of the Chinese shipwright, although ingeniously conceived and skillfully carried out, is of the crudest. This necessarily makes the caulkers' task a formidable one. Yawning apertures between the planks, deficiencies in the wood, careless clinching of nails and other minor errors of omission and commission demand a lavish use of putty, known as *chunam*, and bamboo shavings, or other material, often graving pieces of considerable size have to be inserted to fill up the larger gaps.

"In this connexion it is interesting to note that Marco Polo wrote of caulking as follows: 'The Chinese take some lime and hemp, and these they knead together with a certain wood oil; and, when the three are thoroughly amalgamated, they hold like any glue.' The mixture alluded to was, of course, what is known today in China as *chunam*, which is compound of lime and wood oil, a product of the T'ung nut. In some districts, in order to prevent the caulking from splaying out on the reverse side and necessitating frequent trimming, a plank is placed against the inner side of the seam as a basis on which to caulk. The *chunam* sets hard and white in about forty-eight hours with a good watertight join. In fishing craft today, caulking of large seams is carried out with a mixture of oakum and discarded fishing nets. The net is beaten soft, cut into strips, smeared with *chunam*, and hammered into the seam."

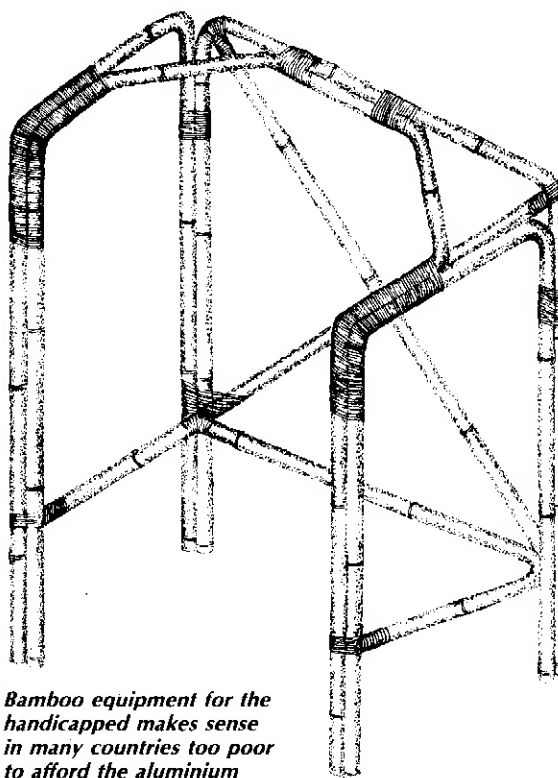
From the highly recommended *Sail and Sweep in China* by Worcester (1966: 8–9): Nine plates of models from the junk collection of London's Science Museum illustrate the history and development of this amazing vessel and provide hints for building bamboo model ships and rafts in schools. Worcester's book deserves reprinting, for its prolonged, firsthand, first-rate research; its lively intelligence and wit, sharp observing eye, and feeling heart. Those with no previous knowledge of junks who couldn't even imagine an interest in the subject are in danger of being infected by the author's own rambling fascination with his theme. Those

concerned with appropriate village technology in developing countries now will find much to ponder. (For related matter, see *fishing, junks, rafts, sails*.)

CHARCOAL. Charcoal from bamboos is generally used in goldsmithery; it has properties that make it superior to conventional sources for use in electrical batteries.⁴⁷

CHISELS. Chinese sculptors "use small chisels cut from the hardest part of the bamboo halms, and they are very expert in the use of them for carving plaster and such like soft material."⁴⁸

CRUTCHES AND OTHER EQUIPMENT. A 1976 symposium at Oxford, England, on appropriate technology for the disabled in developing countries included a display of bamboo and rattan aids for handicapped children designed by J. K. Hutt, an English physiotherapist working with spastic children in Johore, West Malaysia. Her choice of material was dictated by the high cost of imported equipment, hard to repair and unsuited to the customs of the local people, in contrast with the local availability of rattan and bamboo, together with craftspeople



Bamboo equipment for the handicapped makes sense in many countries too poor to afford the aluminium and stainless steel that affluent nations consider the hospital norm.

ple in any village skilled in construction and repair with these native resources.

Good quality cane also withstands the changes of a tropical climate, is cheaper than wood or metal, is more pliable and when heated can be moulded into almost any shape which it then retains. The woven network used for seats and backs of chairs, etc., allows the air to circulate and thus reduces perspiration and subsequent heat rash.⁴⁹

The working drawings for this equipment, published in a brief volume, are being requested by countries such as Jamaica and Mexico and should prove useful in any developing country, particularly for wounded in the wake of the revolutions sweeping the planet. Drawings for a number of chairs and walkers are included, some of which would prove useful also for infants just beginning to walk. (Address in bibliography under Hutt.)

D	Dams, defensive fortifications (palisades, revetments), deodorizers (dried leaves for deodorizing fish oils), desks,	diesel fuel, dikes, dirigible, dolls, domes, dowel pins, dredge (fishing), drogues, dustpans.
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Defense department.

"For defensive works *Bambusa blumecana*, a species very similar to *B. arundinacea*, serves well. It forms an impenetrable fence on account of its numerous dependent branchlets armed with copious sharp thorns, and such fences are generally planted around and in the trenches of the Malay fortifications and redoutes. These fences form serious obstacles to advancing troops in war and have been recognized as such by the Dutch military men who employ at present the same instead of palisades; for they prove more durable, really quite impenetrable, and against them even European artillery can do little. The same sort of bamboo is also extensively employed for fences around villages in tracts where tigers are uncomfortably numerous."⁵⁰ World War II demonstrated the sturdy capacity of bamboo to withstand A-bombs and bullets: "A flash over the city of Hiroshima on August 6, 1945, announced the arrival of the most horrible havoc imaginable. In the face of the world's first atomic bomb, within a matter of seconds streets and houses collapsed, trees and grasses were charred to bits and 200,000

souls—one half of the city's total population—perished. Some people who managed to survive the near-annihilation developed what is called the 'atomic disease' and died one after another. Today, twenty-seven years after the fateful—and to many Japanese the most unforgettable—day, a few patients succumb to the dreadful disease every month . . . In the wake of the relentless destruction, however, one living thing held out. In the very epicenter, a thicket of bamboo stood through the blast, suffering only one side to be scorched.

"The sight was an immeasurable encouragement to the war-shattered citizens. But the plants were not allowed to stay there long; they were dug out to build the Memorial Museum for Peace, and a portion of the plants is now housed in the Museum.

"During World War II, bamboo thickets often provided shelter to the Japanese soldiers under bombardment. They knew that the hard, enamel-like bamboo stalks could repel bullets and protect them. As an ex-soldier thinks back on the War, he recalls the strange sound of bullets ricocheting in the wood."⁵¹

While Japanese soldiers were listening to the weird *zing* of bullets searching for them in the South Pacific groves, halfway round the globe the Emperor's enemy was investigating improvements in bamboo revetment construction at the USDA Experiment Station in Puerto Rico. The U.S. Army had found the conventional revetment construction with sand-filled burlap bags unsatisfactory for two reasons: Often the bags were locally unavailable, and their life under tropical weather conditions was extremely short. A month after brand new, burlap in the tropics can be very old. A revetment of living bamboo culms offered the advantage of being a material readily available in much of the war zone providing defensive fortifications that, like wine, improved with age.

Bambusa vulgaris was selected as a readily available species quite easy to propagate. Though not a very strong bamboo, tests of water-cured *B. vulgaris* culms showed a maximum fiber stress of 14,960 pounds per square inch. It should be noted that soaking bamboo culms in water leaches out starch, which renders them less attractive to beetles, and therefore more durable, but also makes them more brittle and weak. Even so, the weakened culms of a relatively softwood bamboo compared favorably with the wood of hickory, which has a rupture modulus of roughly 20,000 pounds. The quality of fracture in bamboo is also useful for mili-

tary defenses because its tenacious fiber splits but does not fragment easily: Hit by gunfire, pieces still hang on stubbornly by long stringy strands to a splintered culm.

Young bamboos whose side buds have not yet developed branches are recommended. If these are placed in contact with moist earth, a mass of roots proliferates around their base as well as from the root primordia that circle the basal nodes of *B. vulgaris* and a number of other tropical species. In a living bamboo revetment, roots at both these locations serve to nourish and anchor the wall. In the experimental revetment described, a 2-foot trench 14 inches wide was dug, care being taken to provide good drainage since bamboos love water but abhor bogs. Culm sections 18 feet long were placed in the trench, base down. Only basal sections were used, planted as close as possible to one another and then covered with clumps of grass for shading. Grass clumps were held in place by split culms tied to verticals. Horizontal hardwood poles were wired across the inner wall, at 3-foot intervals, thus uniting the entire wall. Fertile soil was used for back fill to encourage good development of basal buds, and posts were buried in it, from which guy wires were fastened to the horizontal hardwood poles in the revetment.

Large openings between the bamboos of the wall were chinked with grass clumps, their roots in the back fill helping to web and stabilize the soil. Guys were also attached to living culms planted horizontally in the back fill, their tips protruding through the palisade and wired to the horizontal hardwood members. Above the base of these horizontally planted bamboos, vertical bamboo vents were placed to assure they would not be completely smothered by the back fill. Three feet behind the palisade at 2-foot intervals, vertical bamboos with the nodes removed were buried in the back fill to facilitate irrigation and fertilizing: the culm tops protruded from the ground, and into these water and fertilizer solutions were poured.⁵²

Thankfully, these building principles can also be applied to peaceable ends, such as contour barriers for erosion control on steep hillsides, wind-breaks, terracing, stabilizing small pond dams, live fencing, and general landscaping.

DIESEL FUEL. Soaring oil and gas prices have prompted interest worldwide in alcohol fuel. Although crop residues and tree crops could serve this purpose, attention has focused more on grain, cassava, and sugar cane. Bumper harvests in 1982

in the United States mean many more millions of dollars spent storing wheat, soybeans, sorghum, oats, barley, corn, and rye. Using emergency storage in boxcars and other improvised silos cannot fully confront the abundance, and there is talk of simply letting corn and sorghum rot unharvested in the fields to help cope with the plenty problem. In this context, fuel from grains seems to make a lot of sense—but if exporting nations begin to use up their surplus in alcohol fuel production, this amounts to an increased monopoly by the haves of the world's croplands and diminished food for the poor, particularly the city poor in developing countries.

Food or Fuel: New Competition for the World's Croplands (Brown 1980) examines the trend. New Zealand, for example, to fully meet fuel needs by the year 2000, would require an area equal to her present entire crop acreage. In Australia, 15–20 percent reliance on fuel from wheat would consume 100 percent of her crop of that grain. In the United States, 100 percent of the grain harvest would cover 30 percent of current automobile consumption. At current average use levels (10,000 miles per year), one motorist would require 8 acres annually—enough land to feed nine people in the United States or thirty-nine in underdeveloped countries where fewer grains are lost in inefficient conversion to pork and beef.

These figures don't count the liquid fuel used producing the grain crop to begin with. In Brazil, crop use by the 20 percent at the top of the economic ladder will triple—from 1 acre to 3—with the present shift to grain gas. All this in a context of rapidly increasing population and rapidly diminishing land: One-third of earth's presently arable land may be lost by the turn of the century. Third World food production must double before the year 2000 to maintain present deficient standards. Estimated available arable land by the year 2000—940 million hectares—roughly equals what abusive use has already turned to deserts: an area the size of the continental United States, too little to feed the world on, far too much to have thrown away.⁵³

Granted this sobering planetary resource inventory, Brown concludes: "A carefully designed alcohol fuel program based on forest products and cellulosic materials of agricultural origin could become an important source of fuel, one that would not compete with food production."⁵⁴ In this careful design, what place bamboo? First, we could remark that as the valleys fill up, humanity is taking more and more to the hills—then shortly after our arrival, the hills leave for the valleys. China is a

notable exception to our disastrous agricultural practices on sloping lands. Or, more accurately, her errors are more remote in time, and she is now setting about mending them with greater will and urgency than the rest of us. In any case, her old favorite, bamboo, provides a hillside crop whose harvest does not disturb the soil: "I know of no other type of plant growth that can yield an annual crop and at the same time serve as an effective year-round long term protector of watersheds."⁵⁵

A second characteristic of bamboo's growth that makes it attractive for fuel production is its abundance: yearly increment in tree species is 2–5 percent. In bamboos, there is a 10–30 percent annual increase in the bulk of the grove.⁵⁶ We won't enter the complex details of fuel production from bamboo.⁵⁷ Its feasibility depends on many factors, but its productive capacity and ability to thrive on and protect marginal land recommend bamboo for study in any program investigating fuel production from vegetable sources.

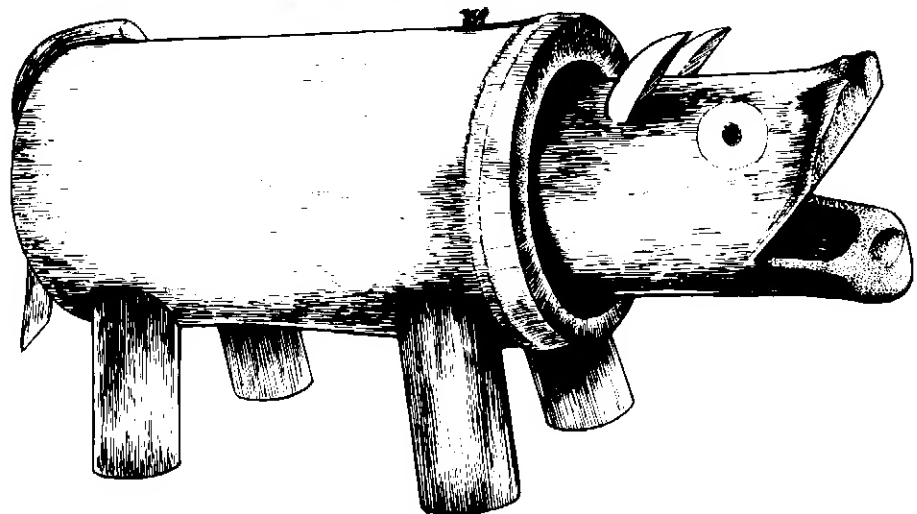
DIRIGIBLE. Alberto Santos Dumont, Brazilian fore-flyer of modern aviation (1873–1932), in 1901 constructed, of bamboo, the dirigible *Brasil*, flying in it from the park Saint Cloud to the Eiffel Tower and back (11 km) in 30 minutes.

DOLLS AND APPROPRIATE TOYS. Just as models serve as a useful tool-up for child architecture, handmade, homemade dolls can function as a miniature training zone for a sense of character and costume that can later be amplified into the art of puppetry and theater. Since we forget process in product, children are more and more conditioned to believe that the only real dolls are those that come in a box. They are not born from their own

fingers, but adopted from a machine trained to make them but not care for them. Rilke considered dolls as they existed in his time and place a sad initiation into the received, ready-made nature of modern life. He never experienced the vital role of dolls in other cultures such as the Hopi, whose magnificent katchinas are a cottonwood Chartres. They function in the Hopi culture as stained glass did in medieval Christendom. Art can be distinguished from argument or ad or mere theology or party line because many non-Christians can "believe" in the breathless beauty of the rose window who do *not* believe that Jesus is the only log floating in our shipwrecked seas, and you don't have to be a Hopi to appreciate the complex celestial anatomy embodied in katchinas.

Appropriate toys, made by local people of local materials, are not built to confuse the child with plastic longings, but to make life clear and initiate the participation and relationship that is the essence of our social existence and social universe. *Tools* were recommended by Plato, Queen Victoria, and many others between them and since then as the most appropriate toy. With tools, the child himself becomes the doll, living out and imitating work rhythms vital for survival. Toys are not marginal to schooling in traditional cultures, but aids at the blooming center of learning to pass the culture on from mind to mind and hand to hand. We imagine the modern urban child's life as more "rich" in educational options than traditional children's, but examine the number of materials that modern children can explore and get to know in their toys and how much real texture is left in them, uneraser by machine production and computer design. Compare this with the generous range of fiber and color, feather and leaf provided everywhere by

This bamboo pig with movable head can be made in many sizes, from very small—an inch or two—to riding size for a child, with a drum stretched on the rear end. The multiple use of space characteristic of the Japanese house is imitated in multiple-function toys that serve as friend, furniture, and another instrument for the family band.



earth to any village child. Coached early to look for them, our children could find as many dyes as George Washington Carver, the "Wizard of Tuskegee," coaxed from the clays and plants of Alabama, including a dazzling hue in which Egyptologists were amazed to find the lost radiance of Tutankhamen's blue (Tompkins 1974).

Bamboo dolls and little animals have been the standard do-it-ourselves playtool of oriental kids for centuries. Twig bones, leaf body, sheath hat . . . thousands of variations have been demonstrated. Find them in the twigs and trash of your neighboring grove, along with others never found before your fingers gave birth to them in the watching eyes of your child.

Better a laughing and learning child on the planet, planting a carrot for his homemade doll with his real tiny spade than a man on the moon planting the flag of whatever imaginary nation . . . whose name, pride, and fall the moon will not remember even if you pave her surface with memorial plaques. An appropriate history is the luxury of appropriate cultures, impossible without the appropriate child. Toys are the magical *other* to the child; the environment is the prince that kisses our capacities to awaken creation. We are only in relationship. The early qualities offered by our environment for relationship determine largely our later capacities for creative exploration of the other, the new; toys are supercritical in learning to learn.

The boldest stroke for survival of any nation now would be to replace its war budget with a toy budget of equal magnitude. The deluge of creative human energy that would unleash could float all human navies in the palm of its mind like chips in the Pacific. War will end when we find more contagiously engaging and seductive beckonings to our energies. By invading a nation of complete children, soldiers of more sober, industrious nations never provided in their dull infancy with appropriate toys would become so enchanted with the world and people they had been sent to destroy that they would simply forget the war.

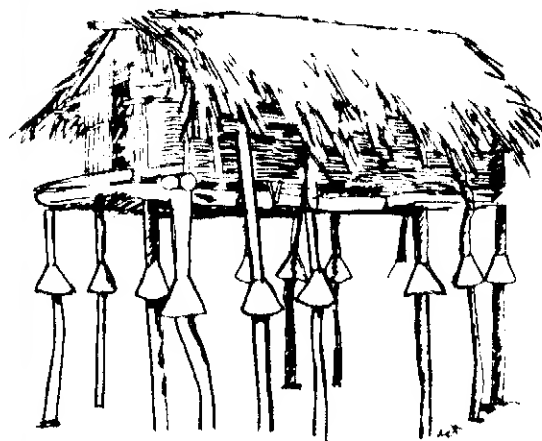
For want of a toy, that world is lost. The chief interest of our history now is that it teeters at that point called in bullfighting "the moment of truth": Will we select the Man and his Bomb, sooty as the devil in a medieval puppet play, or the Child and Toy?

DOMES. See "Bamboo polyhedra" in Chapter 4, pp. 106–107.

DOWEL PINS. "Dowel pins of bamboo are commonly employed by carpenters for joining boards edge to edge in the making of certain articles of furniture such as beds and wardrobes. The best dowel pins are made from the rind wood of *Arundinaria amabilis*. *Phyllostachys pubescens* is also used."⁵⁸

DRYING AND STORING CROPS. Life after harvest is probably the central problem confronting small farmers and large agribusiness around the world. Loss following harvest in Latin America runs 25 to 50 percent; in Africa, around 30 percent; in Southeast Asia, roughly 50 percent. "This means that simple, low-cost, small-scale systems for storage and preservation are critically important, with the potential for more effect on the supply of food available to humans than dramatic gains in agricultural productivity."⁵⁹

Ironically, superproducing new hybrids are often associated with the most dramatic losses: with monocrop hybrids, synthetic fertilizers, and pesticides, greater yields are realized—with the ecological cost in soil fertility, health cost in a less diversified, more packaged diet in the shift from subsistence to market farming, and social cost in increased dependence of country on town. Without wholistic designs that anticipate increased yields with increased capacity to process and store the abundance, the productivity becomes meaning-



"An improved 2-ton storage bin with rat-guards" (Darrow 1981: 484). The theory and practice of rural technologies, such as the crop storage techniques shown here, are being studied in the village schools of developing

countries. Studies and experimental works need to be related to the basic shelter, food, and health needs of the community, and develop rather than destroy the renewable resources presented by the local landscape.

less because it never reaches the poor person's plate; rodents, insects, and molds grow fatter than people do by most modern farming methods.

In areas of its growth, bamboo mats, racks, baskets, sunning floors, and storage cribs are all important in traditional harvest, curing, and keeping of crops . . . from rice in the Philippines to coffee in western Colombia—where ingenious small bamboo buildings have roll-off roofs that can be rapidly returned to cover the building when rain threatens and opened again when the clouds pass by.

The hill tribes of Hainan, the Philippine Islands, and the adjacent mainland of Asia harvest their rice in short "hands" made up of the heads plus a 6 or 8-inch portion of the stalk. These "hands" are cured on a long narrow rack consisting of a row of posts set firmly in the ground with slender bamboo culms bound to them in a horizontal position at close intervals, and to a height of about 6 feet. The "hands" of rice are thrust between these bars in close order and allowed to remain there until they are thoroughly cured before being removed to the granaries. A narrow thatched roof protects them from rain. In the threshing, winnowing, and transportation of the grain, bamboo baskets, trays, and scoops are all important.⁶⁰

Fences for animals, scarecrows for birds, spray guns for insects—all are fashioned of bamboo in the Orient to protect crops both before and after harvest. Other uses are more subtle, local, and specialized: "In the citrus groves of southern China where a certain species of predacious red ant is colonized on the trees to keep down parasitic scales and other insects, bamboo poles serve as a means of intertree transit for the ants."⁶¹

Bamboo matting is an omniuseful artifact in the curing of much farm produce: "Fruits and other products which would be spoiled by contact with the soil are spread out to dry on squares or rectangular pieces of coarse bamboo matting. Similar mats are used as overnight covers or during showers to protect farm produce being cured or dried in the sun."⁶² Drying well is the critical factor in proper storage. Open-air drying is at one end of the scale in complexity and capital investment, with mechanical driers operating on some sort of fuel at the other. In between are solar driers of varying complexity, from a simple roof and woven walls through which air can pass over a stored grain to devices constructed of high-tech materials like glass, aluminum foil, and sheet metal. Fairly low-cost hybrids of industrialized and local materials are

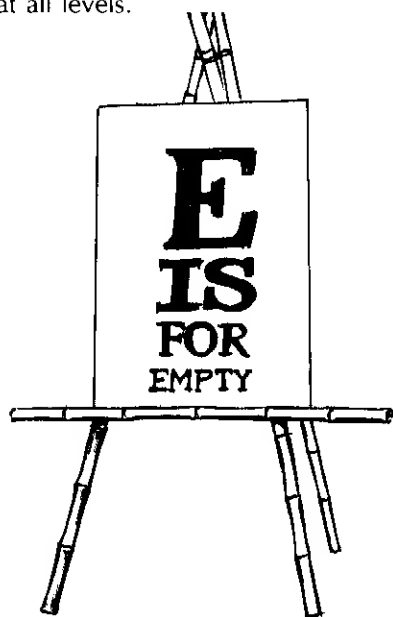
under experimental use: bamboo or other framing with clear or black plastic skin that raises the heat and diminishes drying time.

Crop drying and storage depends on many factors: the crop, local weather, materials, and traditions. Bamboo has proven a very useful material where available, and techniques have evolved in some areas—as in the Colombian coffee-drying houses with their easily removable roofs—which might find relevant application to other crops in other locations. Two constants of alternative technology are to be remembered: *adapting* distant alternatives to local conditions rather than blindly *adopting* alien solutions unadjusted to local contexts; and keeping community involvement in the foreground of all efforts. In reforestation, water supply, cook-stove innovation—whatever change design—workers worldwide have found that an absolute condition for success is *participation of the people*. Central to alternative-technology crop keeping is "understanding the principles of good grain storage and basing improvements on traditional techniques rather than the transfer of an alien grain storage technology."⁶³

A successful grain storage effort in Tanzania evolved the following method: (1) They pooled local knowledge; none of the villagers knew how much they knew collectively. (2) A team of outsiders—Tanzanians and foreigners—provided alternatives from elsewhere in an open way, not as "solutions" but as options to be selectively embodied in local design at the villagers' discretion. (3) The eight-week project was integrated with the primary school; grain storage experiments were performed by the children. (4) Basis for tighter future relationship with the agriculture faculty of the local university was established through concluding the project with a seminar, taught by the villagers to fifty crop husbandry and rural economy students, on village grain storage. "An excellent example of proper, humble technical assistance in the context of real community participation."⁶⁴

In light of the seriousness of the problem of crop storage; considering the extent to which bamboo has traditionally been used with an enormous range of crops in widely varying climates; acknowledging the usefulness of pooling global experience to inspire new hybrid technologies—it would seem relevant for some international organization such as FAO to research the subtle details of bamboo for crop curing and storage in Asian, African, and American agricultural areas. Findings should be published as *graphically* as possible for farmers, not

bureaucrats. Complementary uses of bamboo for farm use should be indicated, as well as its possibilities as an environment doctor for erosion control, windbreaks, or waterway stabilization. Relevant species must be indicated. Where they don't grow presently, they have to be planted in government gene banks at experimental stations. Where they do, the species have to be made more effectively available to the people. As in the Tanzanian project, the effort must be connected with the educational system at all levels.



E

EGGCUPS. One of the most surprising things about bamboo is the poverty of objects made from it beginning with *e*. The enzymes and extracts mentioned above by McClure seemed too abstract.⁶⁵ Erosion control is not a thing but a function, though we considered using it to fill out the *E* section when an obscure article by Freeman-Mitford saved us with a brief treatise that includes the economics of eggcups in England, made of bamboo and imported from France in the nineteenth century.⁶⁶ Bamboo fits well with chickens in many ways: Groves provide a natural roost, protection from predators and weather, and a dense leaf fall sheltering lots of bugs to scratch for. Leaves are also chopped into chicken food as a vitamin A supplement (Squibb 1953, 1957). Some say bamboo leaves also help firm the eggshell. Harvested culms make excellent hen houses. Chickens, in return for these services, provide excellent dung to fertilize the groves. The bamboo eggcup provides a final tiny sample of this interdestiny.

(*U*, *v*, *x*, *y*, and *z* are other letters almost equally empty of bamboo artifacts. We have sought

refuge in various ethnic instruments—dressed in Western names—and exotic architecture to inhabit these waste spaces. In this battle for a bamboo alphabet, we console ourselves with the reflection that, among the orders of existence, though alphabetical order may be among the most useful, it is the least significant. However, in defense of a catalog or dictionary as an art device, it should be remarked that the bursts of unrelated data yield interesting neighbors. Synchronicity imposes randomness on newspaper layout. The alphabet achieves the same arbitrary juxtaposition of news, hinting new associations. Randomness is an important feature of oracles: it bursts the bounds of reason and taste, those confining columns you could tie a donkey to for a thousand years. Inspiration comes in disorderly bits and flashes too hot for the hyperorderly left brain to handle. The alphabet becomes a useful antiorder.)

F	Fans,	floats (for fishing),
	farming uses,	flooring,
	fences,	flowerpots,
	fenders (for ships or	flutes,
	docks),	flying art,
	fertilizer,	food (shoots and
	fiesta assistant,	animal fodder),
	fifes,	forage,
	firearms,	forms (for bean meal
	fire starters,	in oil press, for
	firewood,	reinforced
	fireworks,	concrete),
	fishnets,	frames (for pictures,
	fish poles (and traps),	silkworm culture,
	flagpoles,	and so on),
	flails (for nut	fruit pickers,
	harvesting and so	fuel,
	on),	furniture.

FANS. These are as associated with the Orient as bamboo—from which cheap and sometimes quite elegant varieties are made. Folding fans, introduced into China in the eleventh century from Japan, were more used by men; round, fixed fans—the more ancient style—by women. Fans were so common a part of life in China that the condemned even carried them to their executions. An abandoned wife was known as an “autumn fan”—discarded after a hot spell.⁶⁷ Austin's *Bamboo* provides an extensive series of photos documenting Japanese fan-making in Kyoto:

Traditionally, the operations have long been divided for the sake of economy in manufacture. There are over twenty-five steps in making a sophisticated fan, and even today they are

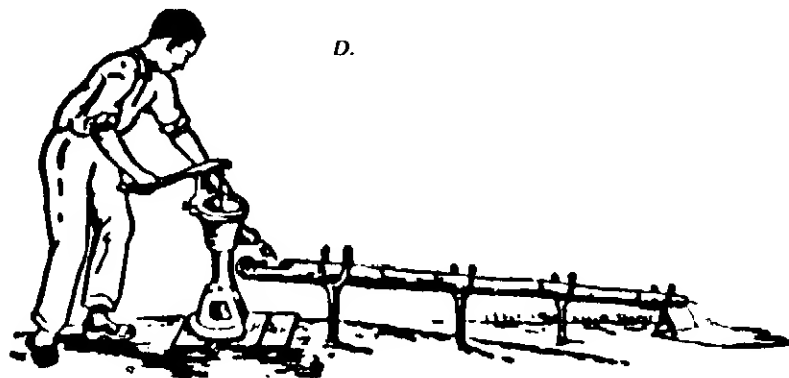
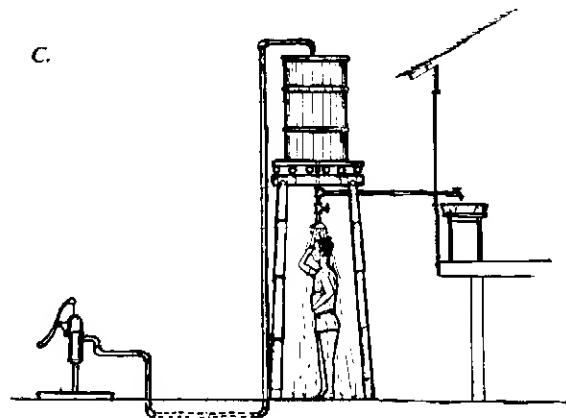
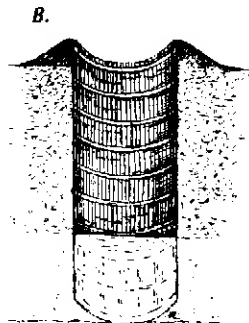
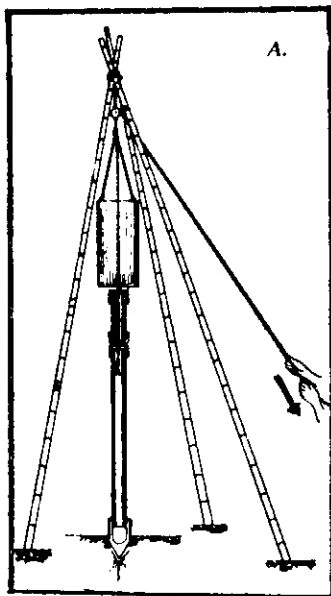
carried out in not less than seven different places, each of which has its own specialty. These are family groups, working deftly in small rooms, whose network of cooperation spreads over the city like the roots of bamboo itself . . . Of late, however, fan-makers have been complaining that air conditioning is threatening their livelihood.⁶⁸

FARM FRIEND. *The Samaka Guide to Homesite Farming* is a plan for Philippine families who wish to produce their own food on a small plot. First published in 1953, the *Samaka Guide* has gone through a number of editions and proved to be a quite popular "how-to" for small farmers in a land where bamboo is readily available and widely used. As such, the guide is an index of the omnihandy nature of bamboo on a subsistence farm where the plant is presumed to be available.

Bamboo use is as everywhere as wood was on an early American farm. The house, to begin with, is framed in wood or bamboo and covered with

sawale, a bamboo matting. The tripod for drilling a well, the walls to line it, and its water pipes are all made of bamboo—and the water will run to the kitchen and shower from the sun-warmed drum on the bamboo tower. Seeds in bamboo seedboxes on a bamboo stand are sheltered by bamboo sunshades till transplanted to a garden (protected by a bamboo fence) to be hoed and raked, trellised and staked with bamboo, harvested in a bamboo basket and eaten, with bamboo chopsticks, in a bamboo bowl. "Homemade fertilizer"—rice straw, leaves, manure, garbage, and weeds—is gathered in bamboo baskets and "cooked" in large bamboo composting compartments.

The guide focuses equally on gardening and livestock, and bamboo seems equally employed in both. A goat shed and holder to still a goat while milking, a bamboo chicken cage with feeders and water troughs of bamboo, duck pens and pig sheds—animal shelter of all sorts and sizes—and a

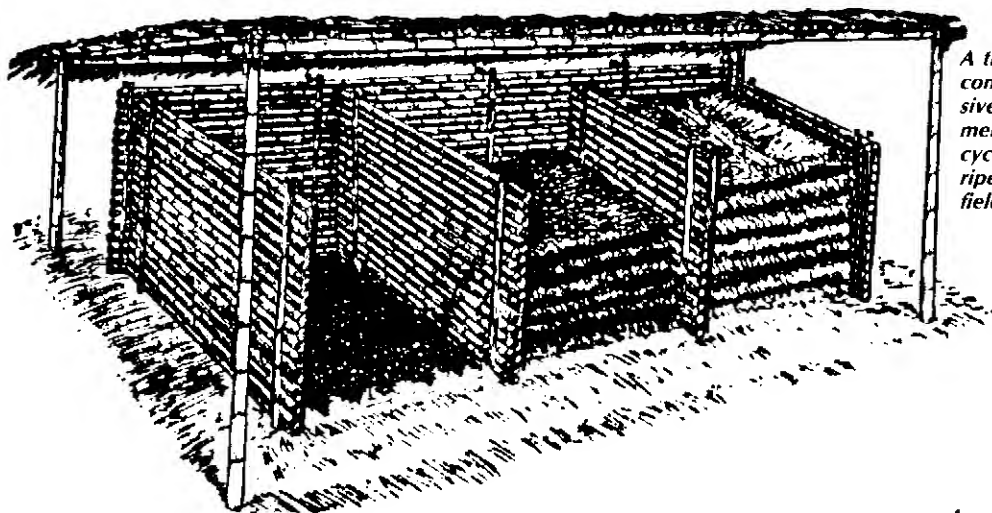


Water systems. From the tripod for hanging the drill (a) to the slats for walls that line the finished well (b); for plumbing in the house (c) or irrigation in the garden (d), bamboo provides homesteaders in the Philippines with a raw material they can grow on location as windbreak and living fence.

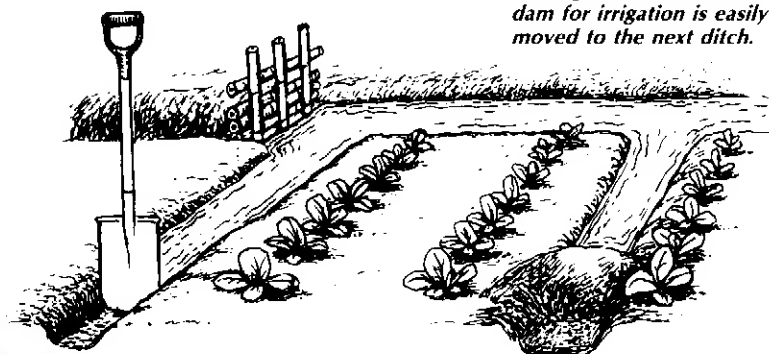
slaughtering table of split bamboo are pictured, together with a bamboo fish trap and dip nets for "our family fishpond."

Although bamboo is the material in thirty-three of the ninety-three illustrations in the guide, no mention is made of its propagation, cultivation, or

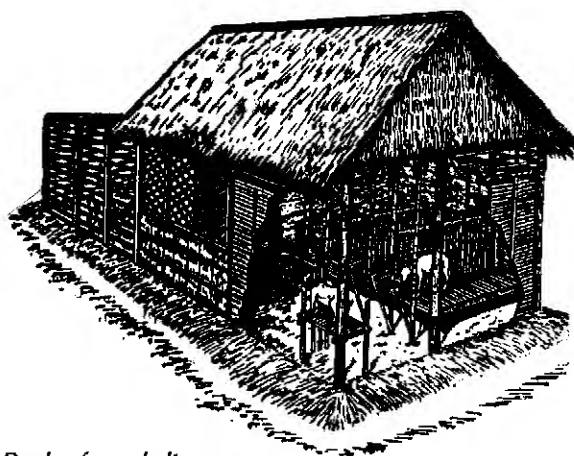
harvest. Fences, houses, sheds, and gates are all constructed of it in the back cover map of the ideal 600–1,000 square meter yard, but no bamboo is listed among the recommended plants. The presumption that because bamboo is plentiful in a given area, it will continue to be so has proved



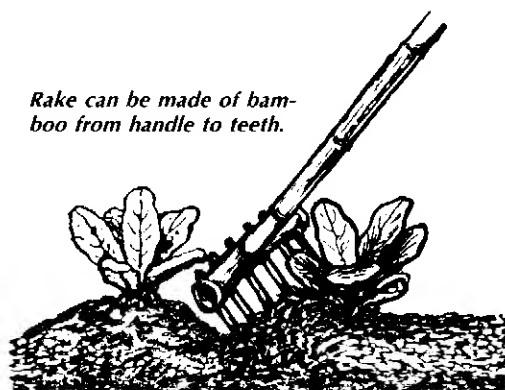
A thatch roof protects the compost piles from excessive rain. Three compartments permit a constant cycle from fresh (right) to ripe and ready for the fields (left).



A cut grass and bamboo dam for irrigation is easily moved to the next ditch.



Duplex farm shelters economize space: shown here, a goat shed/hen house.



Rake can be made of bamboo from handle to teeth.

incorrect in a number of countries. For the guide to neglect teaching people how to grow their own bamboo is a serious omission. The future of bamboo is actually in the hands of those who could profit most from its use—the poorest people living directly from the earth. Their governments, unfortunately, have not been able or willing to subsidize the spread of bamboo rhizomes and information, so the ordinary people in most countries where bamboo thrives are very unsophisticated in its cultivation and have no book knowledge of how bamboo is used in other countries. Relevant information and preferred species should be available to the people at a cost within their means.

In Colombia, for example, although bamboo is actually a very important part of the economy and is much used even in urban construction, it is completely unmentioned in school books about the economy and agricultural produce of the country for grade and high school students. This neglect was characteristic of all Latin American countries we visited from Mexico to Peru.

FENCES. Those made of bamboo are endless in their extent and variation in the Orient, greater, collectively, than the Great Wall—of which bamboo supposedly formed an original component.

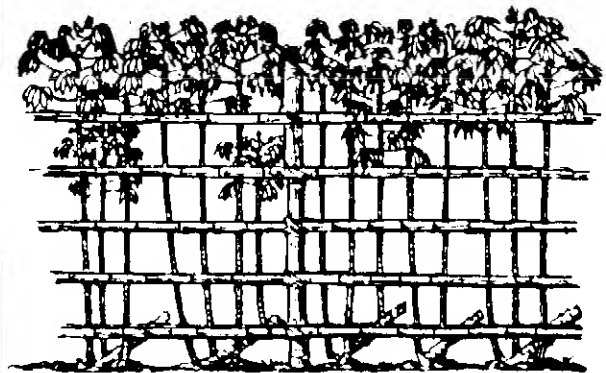
In upright, horizontal, or diagonally lashed whole culms, in bunches of branches, in lathes woven in an infinite manner of ways, in functional walls around properties or merely decorative divisions within a garden, bamboo has perhaps made as many miles of fencing as any single construction material in the world. Tough, light, relatively inexpensive, bamboo fences are most durably constructed sustained by hardwood posts, elevated a few inches above ground level, and set vertically to drain more readily. A large culm split in two and placed as a watershed above poles—or a small thatched roof—gives a more finished look and increases fence life. In unroofed fences of whole culms, the top is ideally cut flush with a node to prevent collection of rainwater.

The chief value of (woven) bamboo fences lies in the fact that they are all-inclusive. Anything, even small chickens, put in an enclosure surrounded by bamboo is really enclosed. Furthermore, it is very difficult to scale them—they are so shakey and springy. They seem so unstable, but in reality a bamboo fence in good condition is superior to anything except the woven wire stock and poultry fences used in the U.S. It may not be heavy enough to withstand a violent attack by a water buffalo—the posts might give way or the

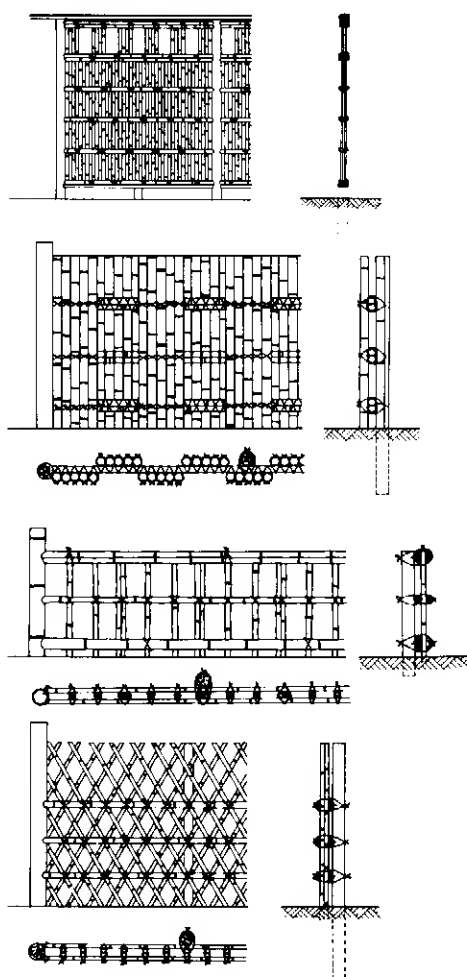
wire fastenings might break—but the fibres would never tear.⁶⁹

Unless you have a water buffalo living next door, you might consider bamboo for alternative fencing.

In sheer bulk, there are few things people use—other than houses—that require more raw material to make than fences. To look backwards down them a bit into their brief history on this continent: Although Ben Franklin experimented with wire for cattle pasture and an "Account of Wire Fencing" was read at the Philadelphia Agricultural Society in 1816, it is only roughly a century since barbed wire (1873) and woven wire (1883) came to loop from post to post across America . . . and then the world. Before this, farms in southern states had even been abandoned for lack of adequate fencing materials when hardwoods such as locust, cedar, chestnut, walnut, or white oak—preferred in that order—were no longer massively available. After the Civil War, the U.S. Army's inventory of 7 million miles of wood fences added up to over \$2 billion invested—at \$300 a mile. Does anyone know the United States or world investment in fences now? As there are more of us and more fences, as the cost of metal and wood soars, the use of bamboo for fencing, proven for centuries in the Orient, makes ever more immense sense. Landowners should be encouraged to grow their fences on location rather than wasting precious energy transporting them, prefabricated, from somewhere else.⁷⁰



Many living plants can provide uprights for a bamboo fence. Pruning at the top creates a denser, bushier barrier. Cassava-bamboo, a favorite Philippine combination, is shown here.



FENDERS. These are used on oriental docks and boats like old tires in the West: "Twenty-five feet of split, tapering bamboo, swiftly twisted into a springy circle and hammered over a fishtub . . . is able to withstand for years the punishment it gets on trawler and quayside."⁷¹ Its durability in this use further testifies to the amazing toughness of bamboo fiber.

FERTILIZER. "The leaves of bamboos that grow wild in the mountains are extensively used as green manure by farmers in Japan. When culms and branches are harvested, it's wise to let them lie in the grove till the leaves have all fallen from them, for the leaves serve as fertilizer for the bamboo. Much used for paddy fields, the leaves of wild sasa are best gathered during the blooming of the wild cherry trees. Sasa leaves are also an effective fertilizer in growing ginger, helping to brighten its red color and increase the crop."⁷² Contrary to popular

belief in some areas that bamboo depletes soil fertility, studies by Ferrar-Delgado (1951) comparing various crop yields in lands cleared of bamboo with regional averages suggest that bamboo maintains or increases the vitality of the soil.⁷³

FIESTA ASSISTANT. Bamboo improvisations embellish ceremonies and celebrations in all countries where the plant is native. Immense towers for fireworks, shelters for patron saints, poles for banners, frames for giants, floats of infinite descriptions in parades, portable altars in processions—bamboo's lightweight and rapid assemblage make it a favorite fiesta assistant that plays dozens of roles in many cultures. Related to these flashy functions is its extensive use in circuses, puppet theaters, and mobile shows of many sorts.

Triumphal arches are another standard structure in bamboo's repertoire. "In the highly ornamented gateways erected over the road to be traveled by an honored guest or conquering hero, the versatility of bamboo as a building material and decorating medium is exhibited to fine advantage," remarks McClure of his experience in China.⁷⁴ Kurz speaks of the same art in Java: "No one who has not seen them can fairly appreciate the skill and taste displayed by the Javanese in this sort of work. Yesterday you saw nothing but a heap of fresh-cut bamboo halms, and today these rude bamboo poles gradually become converted into arches, gates, and structures of the most exquisite patterns, filled out with skillfully wreathed trellis work. Broad and thin strips of bamboo and the soft yellow sheaths of the plantain leaves, taken from the interior layers of the trunk, are folded into artificial stars or flowers and ornamentally arranged, garlands of bamboo material intermingled with natural flowers gracefully hanging in tasteful designs, a few gorgeous bouquets added as a finish."⁷⁵

FIREARMS. Fire starters, firewood, and fireworks: bamboo is as intimately linked with fire as it is with water—appropriately, perhaps, since it is a thirsty plant that flourishes best on sun-drenched tropical riverbanks. Bamboo fiber makes excellent candlewicks; old cables are used for torches; tinder and fire starters of different designs are used in various locations; and some theorists even attribute the origins of human use of fire to the observation of spontaneous combustion in bamboo groves arising from the friction of old, dried culms rubbing against each other.⁷⁶

According to the Greek myth, Prometheus



Bamboo was used to make guns in 12th century China. Metal barrels soon replaced bamboo, but the

metalworkers continued long afterwards to include the bamboo nodes in their designs.

stole fire from heaven—perhaps a metaphor attributing the first human hearth to fires started by lightning. Such fires could have been used and preserved by primitive peoples; but not having lightning at their disposal, it was not a technique for kindling fire that they could imitate. Friction of culm on culm, however, provided an example within reach of human hands. The technique persists in many locations where bamboo is available and matches aren't.

In various out of the way places the people easily make fire by friction from the stems of such bamboos as *B. polymorpha*, and from other bamboos with large cavities and relatively thin walls. The internode is split in two lengthwise, a narrow slit cut through the round back, the hollow beneath this filled with bamboo-shaving tinder, a sharp-edged bamboo strip rubbed across this at right angles like a saw, making hot powdered bamboo drop down through the slit onto the tinder below. When a spark develops in the hot powder, it is blown to a flame in the tinder. Fire may be secured in 30 seconds by this method.⁷⁷

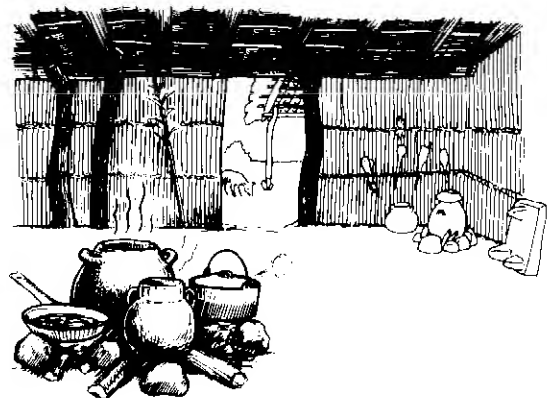
Marco Polo reported the use of green bamboo tied near campfires to explode as the air in the internodes heated, providing an audial wall against

tigers and other savage beasts. The effect on human witnesses was sufficiently impressive to fix a name on the plant supposedly deriving from this quite peripheral use: BAMBOOOM! Whether or not bamboo taught people to make fire, it's suggested that these explosions were the first fireworks, pre-dating by several millennia the first mention of gunpowder—or "firedrug" as it was called—for theatrical performances around A.D. 600.⁷⁸ Gunpowder was in military use in land (mines) and air (arrows and catapulted fire bombs) for some two centuries before bamboo "fulfilled its most fateful destiny," as Needham remarks, as the grandfather of all guns.

In 1233, the use of a "fire gun" by the Chin Tartars is recorded, but this instrument seems to have been a sort of flame thrower. By 1259 an actual gun barrel is recorded, though made of bamboo reinforced with fiber wrappings; the first metal gun barrel is recorded in 1275. For some time after their introduction, however, metal gun and cannon barrels were made ribbed, as though in imitation of the bamboo they replaced.⁷⁹

FIREWOOD. Asked to describe their least favorite disaster—the one of many ugly candidates that most endangers the earth—*deforestation* would lead the list of many most-informed students of how the world's vulnerable balance is being kicked asunder by human mismanagement. Blundering lumbering and clearing forest land for cows, crops, and human settlements are all taking their toll. But a larger chunk of woods than most realize goes up in smoke for fuel. How can bamboo relate to this critical problem? Its magnitude justifies at least a brief sketch of its complexity.

The humid forests of the tropics once occupied at least 1,600 million hectares [4,000 million acres] and have not only been the main centers



Quiz

The underdeveloped countries' share of total world wood use is:

5% 10% 30% 90%

Worldwide, the greatest single consumption of wood occurs in:

forest fires construction pulp manu-
facture firewood

Most of the world's people cook on:

gas kerosene woodstoves open
fires

In the national energy budgets of the poorest countries, firewood needs take up:

15% 45% 75% 95%

Energy use in open wood fires, compared with gas stoves, is:

80% less 20% less 20% more
400% more

In Guatemala, Nepal, and Upper Volta, monthly cooking fuel costs are the equivalent of a U.S. family paying:

\$0.40 \$4.00 \$40.00 \$400

Every year, a village doubles the wood it cuts.

After 19 years of cutting, half the forest still remains. The other half will disappear in:

38 19 9½ 1 year(s).

(In each case, the correct answer is the last.)

for living species on earth, but have held the lands together, moderated and modified world climates, and helped to maintain a desirable balance of atmospheric gases. Now they are vanishing at an incredible rate. There are reported to be 935 million hectares in actual humid tropical forest, a 40 percent reduction in total area. They are disappearing at a rate of 16 million hectares per year.⁸⁰

Some 630 million people live on the dry lip of the expanding deserts of the world, which have already swallowed one-third of the planet's land. The Sahara alone claims 250,000 more acres annually. Modern agricultural practices, overgrazing, exploding populations are all important factors, but perhaps the most critical contributor to the global dust bowl is deforestation—the trunkless stumps left in the parched wake of the 1 billion, 500 million people gathering firewood to burn beneath their dwindling pot of food. From 50–70 percent of *all* wood cut in the world is used for cooking. The average wood-burning family uses 4 tons per year, double the wood consumption of richer countries for construction, paper, furniture, and firewood combined. Firewood in the developed countries represents 0.4 percent of energy used; in the developing world, 25 percent. In some countries, the figure is as high as 87 percent (Nepal) to 94 percent (Upper Volta). In richer countries, firewood claims 10 percent of total wood use; in poorer countries, 90 percent.

Forests influence the wind, temperature, humidity, soil, and water in ways often discovered only after the trees are cut, and these functions—usually beneficial to the people—are sabotaged. Forests assist in the essential global recycling of water, oxygen, carbon, and nitrogen—and without any expenditure of irreplaceable

**Forty to fifty pounds
(twenty kilos) of firewood
makes a good load.**



fossil fuels. Rainwater falling on tree-covered land tends to soak into the ground rather than rush off; erosion and flooding are thus reduced, and more water is likely to seep into underground pools and springs.⁸¹

As the world's forests disappear, and petroleum products soar ever farther out of reach of the planet's poor, dung is increasingly used in rural areas as fuel, which accelerates soil deterioration still more. Land becomes more scarce with greater population, less fertile with ever greater abuse: More people move to nearby cities. There, charcoal replaces firewood, using up to three times as much wood for creation of equivalent energy. It took five hundred thousand years, at least, after the emergence of the human race as a distinct species for our population, in 1830, to reach 1 billion. This figure was doubled in a century (1930). By 1960, thirty years later, 3 billion people were quarreling over the planet's resources; by 1975, 4 billion. At the present rates, 1988 will find 5 billion, 1998, 6 billion people increasing and multiplying on the face of the earth. Trees cannot keep pace with human use—without the careful collaboration of human consciousness and sweat.⁸²

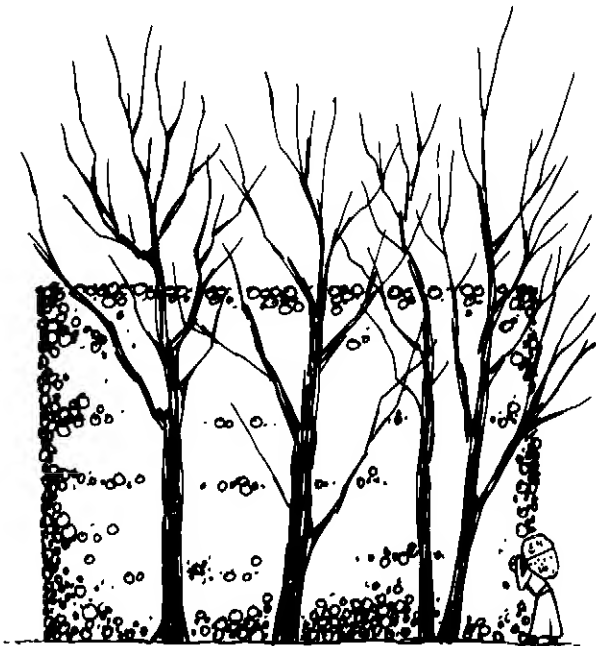
The rate of deforestation in an area is not a steady curve. For centuries, people get their firewood from a local forest. As population grows,

Four loads supply a week's wood; they stack about as tall as the little old woman often gathering them, and are about twice her weight.



wood consumption increases about 2 percent per year. At a certain moment, consumption and natural production are equal. From this point on, overcutting begins to reduce the forest, at first unnoticeably. After nine years, 10 percent of the forest has disappeared. Concern begins to be felt. After twelve years, 20 percent of the forest is gone. Only ten years later, the forest has been completely felled. Beyond a certain point, it is almost impossible to stop deforestation.⁸³

Once use exceeds natural growth, the dangerous and descending spiral increases momentum at a shocking pace. Reforestations in the Sahel, for example, cover 2 percent of the annual loss. "... to supply 30 million Sahelians in the year 2000 ... 3 to 6 million hectares will have to be planted ... 150,000 to 300,000 hectares of forest annually up to the end of the century. ... Nepal will require about 1.3 million hectares."⁸⁴ Forested lands in China have doubled since 1949, however. Green China indicates that reforestation is possible through a national policy in which "tree planting is



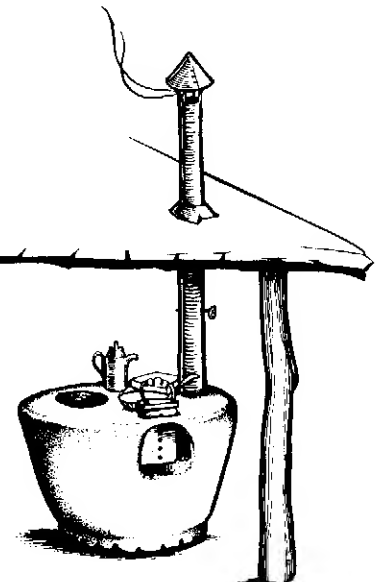
A year's supply—more than two hundred loads—dwarfs the supplier.

everybody's business."⁸⁵ South Korea is another nation where reforestation is actually happening.⁸⁶

Each person in towns in the semiarid areas verging on the Sahara needs one cubic meter of stacked firewood a year for cooking and heating. ... It takes two hectares of natural forest to supply one townperson's needs and, as cities grow, that means a wider and wider search for fuel. It is estimated that by 1990 people will be hauling firewood into Ouagadougou from a radius of 150 km around the Upper Volta capital. But a single hectare of Australian eucalyptus in a plantation irrigated from a river can supply the needs of 50 people.⁸⁷

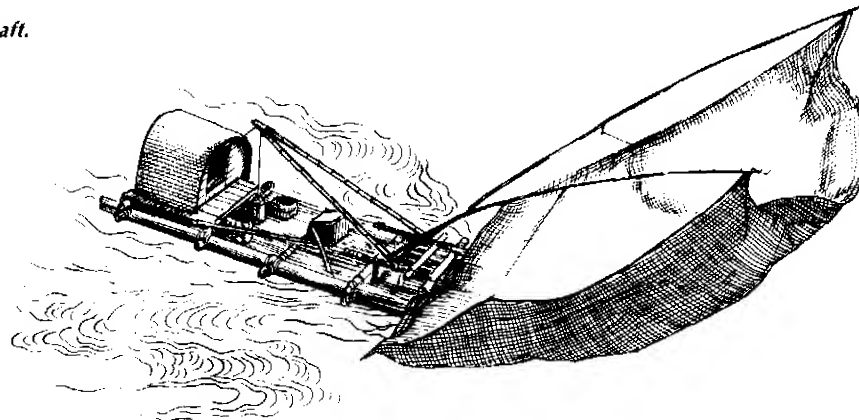
The one bright spot in this rather bleak hearth horizon is—stove design. "Simple stove models al-

Lorena stove: (lodo-arena in Spanish) owner-built stoves of mud and sand developed in Guatemala by Aprovecho, an appropriate technology collective in Eugene, Oregon, feature a tight door to control drafts, pots tailor-fitted to pot holes, and a chimney with draft control. These simple design improvements cut wood consumption by 25% or more and eliminate indoor smoke.



ready in use can halve the use of firewood. A concerted effort to develop more efficient models might reduce this figure to one-third or one-quarter, saving more forests than all the replanting efforts planned for the rest of the century. ... Use of improved cookstoves has an *immediate and lasting* effect on wood consumption with a 25:1 estimated cost advantage over tree planting, providing benefits without a long waiting period ... directly to the households which participate."⁸⁸

The book providing this analysis—*Helping People in Poor Countries Develop Fuel-Saving Cookstoves* (Aprovecho 1981) faces a problem that directly or indirectly touches every person living now or in the burning future. Any action that serves to reduce the acuteness of the world's wood shortage should begin quickly, which returns us to one of the quickest life forms swarming the planet

Dip-net fishing raft.

—bamboo. Bamboo is used as firewood already wherever it abounds and hardwoods don't. But nowhere in print are there reports of any serious government or private efforts to establish groves of the most suited species to take the weight off wood for fuel consumption. *Dendrocalamus strictus*, famous for resistance to drought, might be one useful species.

Bamboo's role as a wood saver in paper pulp production, construction, and manufactured articles is already significant. To these uses, world governments could profitably add fire-bamboo so that the "wood of the poor" could not only shelter them but help cook as much as possible of the world's soup. Providing rhizomes and awareness of the how and why of bamboo cultivation would give people a means for personally, directly kindling solutions to a chilly problem confronting the race. One rhizome of *Bambusa vulgaris* produced 200 culms in five years in one experiment in Colombia. If this plenty could be fed to cookstoves designed for bamboo, it could contribute much to the peace and contentment of our crowded planet: *panza llena, corazón contento*, "full belly, happy heart."⁸⁹

FISHING. If you ask most people in the United States about their associations with bamboo, the most typical response usually includes the springy feel of a bamboo fishing pole from a childhood morning. Bamboo, which grows so well and so conveniently for people who fish by streams, ponds, lakes, and rivers, has many and deep connections with fishing and other aqua-industries of the Orient as well, such as clam digging, and oyster and seaweed cultivation. Its lightness, its float-, flex-, and weaveability are among the chief reasons for its long associations with island cultures like the Philippines or Japan, where as many as 1,000 culms of moso bamboo may be used for the floats of a

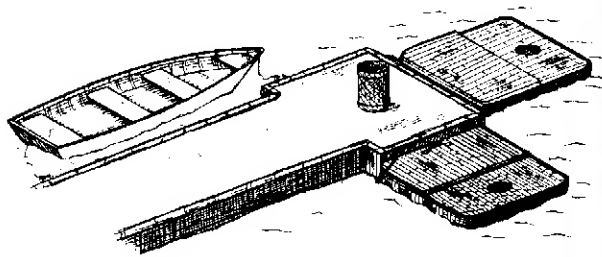
single giant net. Oshima (1931) reports one thousand boxcars, carrying 900 culms of moso each—nearly a million culms—used annually for Japanese seaweed culture. The antiquity of fishermen's alliance with bamboo is embedded in the Chinese language itself.

This fact may be verified by anyone, even though he may not be privileged to see the varied bamboo gear that is an essential part of the Oriental fisherman's paraphernalia. It is sufficient to look up the names of these objects in a Chinese dictionary, for a great many of these complex terms (ideographs and pictographs) contain the symbol for bamboo. This fact signifies that even before their names were first reduced to writing, bamboo was employed in the making of the devices themselves. It is perhaps sufficient for our purposes to mention a few of them: traps, weirs, sluices, barriers, poles for hook-and-line fishing, spears, sea anchors, floats, trays and poles for drying fish and baskets for supporting them, netting needles, poles for drying nets, punting poles, and scaff or dip nets, including karojals and salambas. The dredges, punting poles, sieves, and sea anchors of Oriental clam-dredging equipment are all made of bamboo.⁹⁰

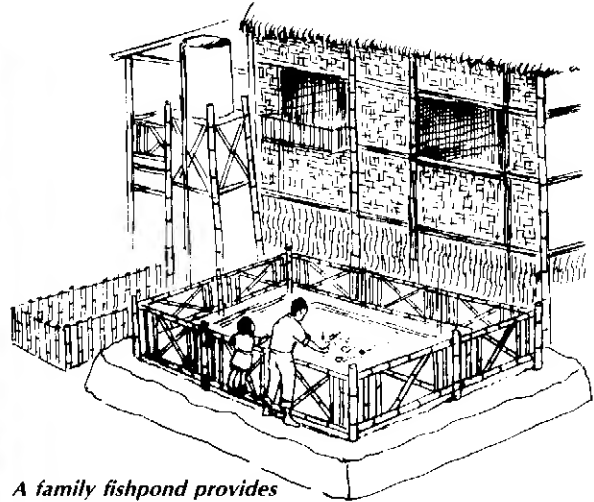
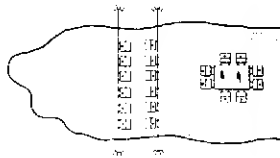
Just as agriculture evolved from hunting and gathering, "water farming" is rapidly evolving in many countries now—from ancient roots. With increasing population, there is ever less land per capita, and that less is ever more eroded and debilitated. The world is two-thirds water to begin with, so more and more people are turning to aquaculture and "ocean ranching" as a partial reply to our race's hunger pains. Turtles, frogs, clams, shrimp, lobsters, eels, and various seaweeds are among the flora and fauna cultivated in addition to many species of fish. Water creatures don't waste energy supporting their weight or regulating body tempera-

ture, and the three-dimensional medium provides cubic acres rather than merely acres to support life, so the yields of water cultures can be considerably greater than terracultures: In Thailand, a fish farmer earns six times as much as a land farmer . . . who in turn is earning more than the average coastal fisherman in that country.⁹¹

Aquaculture is receiving increased interest recently, but its practices are traditional lore of many countries, where it is not an alternative but a complement to land farming. This balance has in some cases been upset by modern agricultural methods, as in Indonesia where the family rice paddy was a complex ecosystem providing a life opportunity for shrimp, frog, eel, and fish cultures along with vegetables, legumes, and tree crops grown with the rice, on embankments, and between crops. A hybrid monoculture rice, using lots of expensive fertilizers and pesticides, reduced or wiped out this delicate balance of food sources, diminished the water creatures and increased the role of bankers in the farmers' lives. Bamboo, in the Orient, has always formed an element in the traditional diversity of agriculture. In aquaculture, it can help construct and preserve the banks of a small pond to begin with. Rafts, nets, docks, floats, rope, and line—much of the bamboo gear of traditional fishing is used in modified ways in aquaculture, and bamboo should be considered a relevant crop on the bank of any aquaculture system. Cage culture, one format of fish farming, presents obvious possibilities for bamboo use. Oyster cultivation in Taiwan, seaweed farming in Japan, are examples of bamboo's alliance with aquaculture we will see elsewhere. In China, 4 million tons of fish per year are produced;



Cage culture: fish farmers in Thailand earn roughly six times as much as fishermen. Cages can be connected to the dock, to parallel cables anchored at both ends to shores, or fastened to a floating raft.



A family fishpond provides an ideal location for bamboo plantings, which help stabilize the banks they drink from. Small ponds can be built above ground in high water zones. A bamboo fishtrap facilitates selection of mature fish.

and their breeding jars, where this abundance begins, use bamboo "showers."⁹²

In the time of the Chin dynasty the people of Ch'ien Tang made a bamboo dam in which they caught a million fish a year. In consequence, it was called a "million worker dam." In the Ming period, a fence of plaited bamboo was built in ponds used for rearing fish. The most ingenious fishing baskets in this period were made of small plaited bamboos. The cover was of woven bamboo splints to which hairy or bristling bamboos were fixed. The basket gradually decreased in size from the mouth to allow the entrance of the fish, but not their exit.⁹³

Tall tale

Fishermen are notorious liars, but here's one story they tell in Japan: Once upon a time in a small mountain village, a small boy went to cut bamboo shoots. The day was warm and he hung his jacket on the tip of a "bamboo child" (*takenoko*) as the new shoots are called in Japan. Then he walked slowly through the grove between the towering culms, barefoot, carefully listening with his toes to the forest floor for the slight bulge, which you could feel before you even saw it, a sure sign that a sweet white shoot was waiting in the rich black ground beneath, just ready to break through the surface of the soil. There you would scrape together a mound of loose soil so that the shoot could grow a bit more before reaching sunlight, which quickly made the tender flesh of the new culm tough

and bitter, excellent in time for a thousand things, but no longer possible to eat.

A bright but bamboo-muted sun filtered softly down through deep masses of tiny foliage far overhead, leaves alive always—even when the breeze died—with a slight tremor that made the very air tremble with vitality. And when the wind lifted again, culm leaning and scraping on tall culm hidden somewhere high above in those gangs of green loveliness, groaned like grandfathers in a troubled sleep . . . sounds eerie and ancient, full of a huge hollowness, murmuring resonant mysteries, moaning and creaking like a door in dreams, sounds weird and wonderful, which took all time away.

At that moment, something in the boy prompted him to glance back to the shoot where he had left his jacket. The culm was growing so quickly that his coat was already out of reach! He ran back and began clambering up to retrieve it—but the culm was stretching up so fast that he soon found himself above the tallest bamboos in the grove . . . above the forest . . . higher than the surrounding mountains . . . taller than the clouds. Far, far below he heard, a little later, his parents calling him. "Up here!" he yelled back down to them. "Hold on tight," they shouted. "We'll cut you down." When the culm started falling, he held on tight for a day and a night, and the next morning—*thump*—the giant culm landed, its tip just reaching the ocean beach. The boy stood up and gazed in amazement out to sea. Nobody in his mountain village had ever seen it before.

Meanwhile, back in the mountains, his parents and friends had climbed up on the immense culm and had begun walking down it to find him. Each node was so enormous that crossing was like climbing wall after wall . . . but finally they reached the tip and found not only their son, but the sea as well. And they found fish and lobsters, oysters and pearls and seaweed—all the abundance of the deep ocean—led by bamboo.

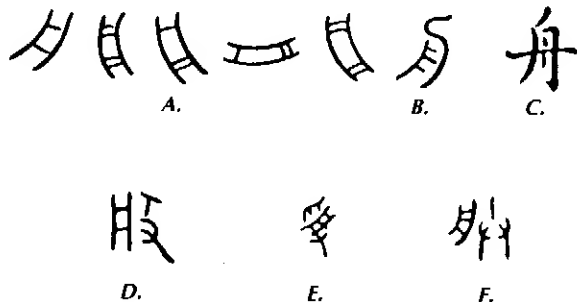
No single gloss exhausts this tale, but among its meanings lies a magical shorthand for the ancient link between bamboo and the fishing industries.

The culm reaching from the mountains to the sea suggests as well the bamboo rafts floated from inland groves to ocean ports, in some times and places in the Orient up to ten thousand poles in a raft (Piatti 1947). Used for transport of freight and passengers as well, these giant rafts were made of a multitude of culm-length rafts stacked end overlapping end, like roof tiles—or like sections of the bamboo culm itself.

Bamboo not only led oriental peoples to the sea, but onto it as well. Just as Hidalgo (1974: 206–10) traces the formative influence of bamboo

on classical expressions of Indian architecture such as the dome of the Taj Mahal, Joseph Needham, in *Science and Civilization in China*, returns again and again to the ghost of bamboo hovering within oriental ship design. He notes that the "ancient pictogram for a boat shows ends which are square and not pointed" (Needham iv.3:396). The reason is simple:

The basic principle of Chinese ship construction was derived from the example of the bamboo stem with its septa, and indeed . . . the earliest vessels of East Asia were rafts of bamboo. This led directly to the rectangular horizontal plan. The following corollaries resulted: *i*) The absence of stem-post, stern-post, and keel; *ii*) the presence of bulkheads, giving a hull very resistant to deformation and leading naturally to *iii*) the system of water-tight compartments, with its many advantages. These were almost surely in use by the +2nd century, but were not adopted in the West until the end of the +18th. Provenance was then recognized. *iv*) The possibility of free-flooding compartments, found useful both on river rapids and at sea. This was not adopted to any extent in Europe. *v*) The existence of a vertical member to which the axial rudder could be attached, in "line closure" rather than "point closure." (Needham iv.3.sec.29 Shipping: 395)



"Boat" ideogram. The Chinese word for boat has blunt ends in the early pictograms, and cross lines suggesting both the nodes of the living plant and the bulkheads of Chinese boats. The curved, dancing motion of most of the ideograms suggests both the rocking of water life and the curved line of early rafts. Chou: a boat. (A) Oracle

bones, Shang dynasty, 1766–1122 B.C. (B) Shou wen (small seal), A.D. 100 (C) Modern form. Notice the node. Bronze inscriptions, Chou dynasty, 1122–255 B.C. (D) To row (a boat, oar, and hand). (E) To receive (a boat between hands loading and unloading it). (F) To caulk (a boat with two hands stuffing a seam).

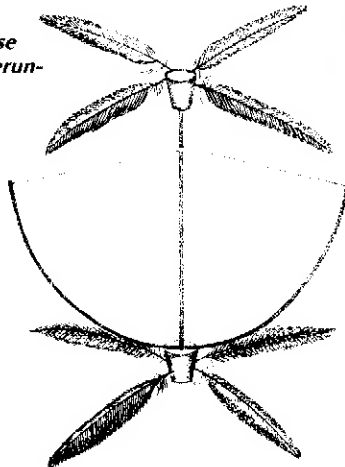
The nodes of a bamboo culm inspired watertight bulkheads in Chinese boats that evolved from bamboo rafts. Western shipbuilders began imitating this method of keeping a damaged vessel afloat about 250 years ago.



Bamboo was a model, therefore, not only to Eastern painters and moral philosophers, but to shipbuilders as well. Earlier in his study, as enormous as the civilization it describes, Needham briefly mentions a seminal influence of the plant on the form of Chinese architecture.

Here we need only stop to remark the striking similarity between the bulkhead structure of the Chinese ship and the prominence of the transverse partitions or frameworks so fundamental in Chinese architecture. If the latter prevented a longitudinal vista and permitted the classical curve of the roof, the former provided distinct holds, rendered the vessel extremely strong, and gave it the typical bluff bow and stern of large Chinese craft. One cannot but feel that both systems were inspired by the bamboo, that plant so familiar to every Chinese from a thousand uses, with its transverse nodal septa. (Ibid.:391)

Flying dragon. Chinese bamboo toy, the forerunner of helicopters.



FLYING ART. Bamboo's use in flying art preceded by some two millennia the art of flying. A fourth century B.C. bamboo bird flew three days⁹⁴; "wind zithers" and "hawk lutes" were early forms of bamboo musical kites; and bamboo whistles were attached to the tail feathers of pigeons.⁹⁵ The "flying dragon," a famous fourth century (A.D.) wind toy, has been called by Needham not only the "direct

ancestor of the helicopter," but also "godfather of the aeroplane propeller." In 1792 "it stimulated Sir George Cayley, who may truly be called the father of modern aeronautics, to his first experiments on what he afterwards called 'rotary wafts' or 'elevating fliers.'" For more on how bamboo helped father human flight, see *kites*, below.

FURNITURE. Bamboo furniture has enjoyed waves of periodic popularity in the West. Freeman-Mitford mentions some thirty bamboo furniture manufacturers in London in the late nineteenth century.⁹⁶ Bamboo furniture seems increasingly visible in West Coast stores in the United States, so perhaps such a wave is about to crest among us again. It has been the mainstay of the oriental home for millennia. Building bamboo furniture was introduced into Philippine schools as a good way for training students in manual arts while providing needed furnishings to the poorer homes (see Cocannouer 1913).

G Gabions, grain storage, games, graters, garments, greenhouses, gates, gate springs, guns, (and bars), gutters, grain, gypsy vans.

GABIONS. Bamboo "sausages," 10–20 feet long, woven of bamboo strips and then filled with rocks, are a characteristic feature of Chinese hydraulic engineering in sea walls and river embankments. They seem to have been introduced as early as 28 B.C. "The relative lightness of the gabions permitted their use on alluvial subsoils without deep foundations, and their porosity gave them a most valuable

Gabions, an early and surviving mainstay of Chinese civil engineering, are essentially huge, loosely woven bamboo baskets full of rocks used to stabilize riverbanks and water-fronts. An empty gabion is pictured.



shock-absorbing function, so that surges and sudden pressures did no damage to the defenses."⁹⁷ Footbridges were constructed across streams in the same way, composed of fieldstones held in place by strips of bamboo, forming a series of stepping-stones of what was essentially a very open basket of rocks.

GAMES AND GAMBLING. The Chinese are such avid gamblers they even bet on the number of seeds in an orange. The word for gambling in Chinese contains the radical for bamboo, supposedly because of its early use for tallies and slips to record scores. In many games, also, bamboo serves as playing pieces. Mahjong, for one, uses bamboo tiles. In some dance games, long bamboo canes are used, as in the Philippine *tinakling* poles, clapped together by two children as a third dances in and out. "Legend says that these giant rhythm sticks and the dancers that move around them are artistic representations of the Philippine lake shore where the long-legged crane wades through windblown reeds."⁹⁸

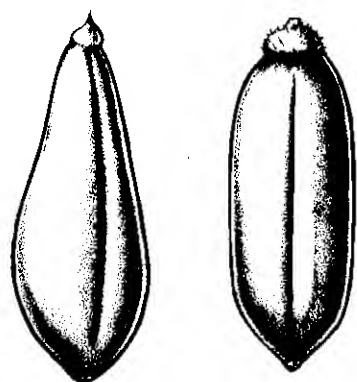
GRAIN. Bamboo was originally classified as one of the seven thousand varieties of rice, to which, as a grass, it is related. Most species flower so infrequently that we don't ordinarily think of it as a grain; but in China and India there is a saying that bamboo flowering foretells famine, and the plant generously spills its seed at this time to help the hungry people. According to oral tradition, this has occurred often enough that some think flowering is caused by prolonged drought. In any event, many records from many locations tell of bamboo grain providing famine relief. "In 1864 there was a general flowering of the bamboo in the Soopa jungles in western India, and a very large number of people, estimated at 50,000, came to collect the seed. Each party remained about ten to fourteen days, taking away

enough for their own consumption during the monsoon months, as well as some for sale. Mr. Stewart adds that 'the flowering was a most providential benefit during the prevalent scarcity.' Six years ago (1921) there was a famine in Hunan, but the bamboo flowered and saved the people. Enough was gathered for food and some in addition for sale in the markets. However, calamity as well may follow flowering of bamboo. In Brazil, as well as in India, sudden production of great masses of rich grain in widespread localities increases food supply for rats and mice to multiply in extraordinary numbers. After consuming the fruit of the bamboo, they overflow into the neighboring fields and devour the crops. The German colonies in Rio Grande do Sul and Santa Catarina were visited by this plague, called 'ratadas' in Brazil, at intervals of about thirteen years, which apparently represents the periodicity of the species covering that region."⁹⁹

It should be remembered that natural stands of bamboo are sometimes immense: Groves of *Mclo-canna baccifera* can cover up to 700 square miles. The tropical groves especially can be quite dense, and among species that fruit heavily you can literally scoop the seed up in your hands. In places, it seems to have fallen not off a tree, but off a truck. The seed generally resembles other grasses. Of *Arundinaria hookeriana*, a species from Sikkim later named after him, Hooker writes: "The fruit is a dark, long grain, like rice; it is boiled and made into cakes, or into beer, like Murwa."¹⁰⁰ An analysis of the seed of *Bambusa tulda* showed: water, 13.5 percent; protein, 10.8 percent; starch, 71.6 percent; oil, 0.6 percent; fiber, 2.1 percent; ash, 1.4 percent.¹⁰¹

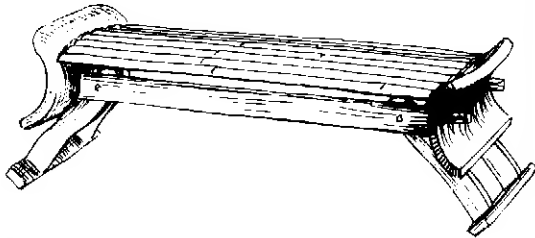
GREENHOUSES. Bamboo and plastic greenhouses are a rapid way of getting more garden space in northern climates. Their construction is particularly recommended for schools. Polyhedra framing (see pp. 106–107) or conventional construction can be used. Plans for a renter's greenhouse in wood, easily built and unbuilt, are available from Aprovecho.¹⁰² Other greenhouse designs are widely available in gardening books and can be adapted to bamboo framing.

H	Hairpins,	helmets,
	hampers,	hen houses,
	handles (rake, hoe,	hinges,
	umbrella, and so	hoops,
	on),	hookahs,
	hats,	houseplants,
	hawsers,	houses,
	hay and forage,	humidors (tobacco),
	hedges,	hummers.



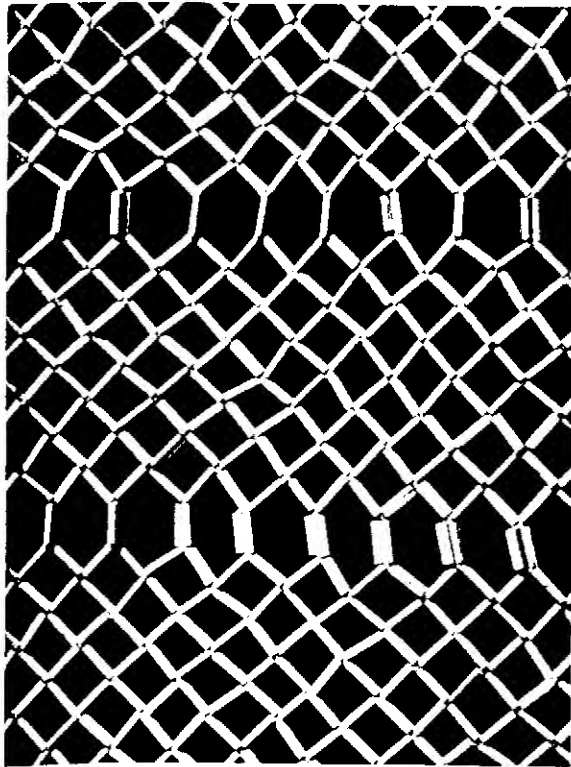
Bamboo seed.

Headrest, Szechuan, early 20th century. 4" high, 5" wide, 13½" long. Portable, with legs folding inward. A good bench design, on a slightly larger scale, for mobile furniture.



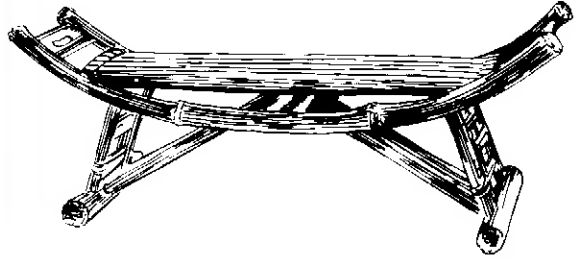
HATS. "In most parts of Burma, the farmers' sun hats are made from the culm sheaths of giant bamboos, bound around the edges with split bamboo."¹⁰³ Oriental bamboo hats are sometimes up to a yard in diameter, more a head umbrella than a hat. Helmets of bamboo were formerly worn by police and soldiers, cone-shaped to deflect blows.

I Iceless cooler, irrigation waterwheels, insect cages, and pipes.



Jacket, 18th–19th century. Tiny tubes of bamboo branches, about ¼" long, were strung on thread in a lozenge pattern then bound in linen with linen buttons and loops. As a summer undershirt beneath a robe, it insulated the body, helped pores to breathe, and kept the robe from sticking to skin. Detail.

Headrest, unknown province, 18th century. 6" high, 4¾" wide, 16½" long. Expanded, an elegant bench.



ICELESS COOLER. In a cool corner of the kitchen, away from the stove, set a bamboo basket with a loose cover on three or four bricks or stones resting in a water container some 12 inches deep, such as part of an old oil drum. Sew burlap loosely over lid and basket so that it hangs below the basket and acts as a wick in the water. The basket itself should be above the water line. Dampen lid occasionally. This iceless ice basket cools food effectively.¹⁰⁴

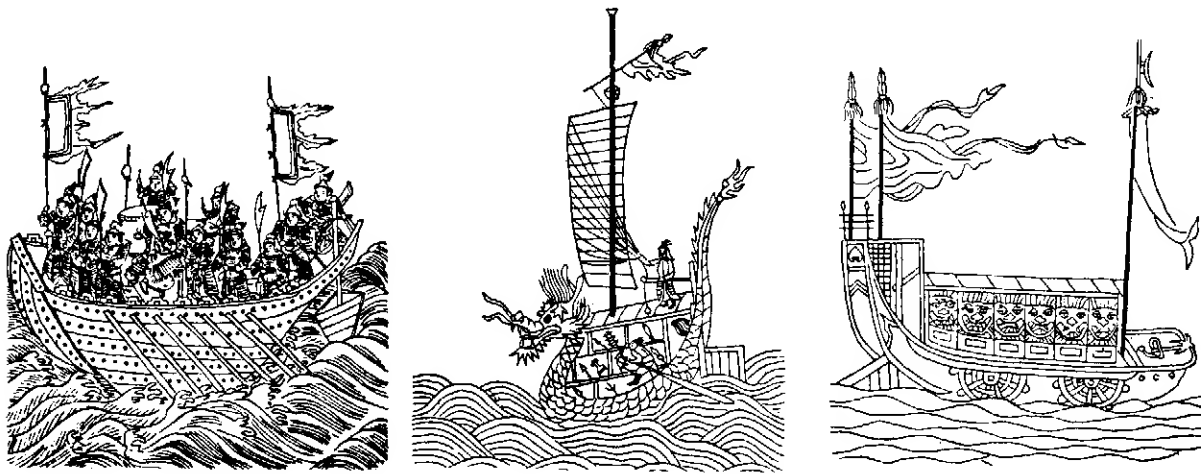
J Jackets, joss sticks, jars, junks, jewelry,

JUNKS. Junks! Spreading their sails . . . cleaving the waves a thousand *li*. Bamboo begat rafts, rafts begat junks, junks begat the rest of Chinese vessels, and these in turn begat critical design modifications in Western ships.

Junk design, exemplified in the oldest and least modified types, has a carvel-built hull wanting in all the three components which elsewhere were regarded as essential—keel, stempost, and sternpost. The bottom may be flat or slightly rounded, and the planking does not close in towards the stern, but ends abruptly, giving a space which would remain open if it were not filled in by a solid transom of straight planks. . . . The hull may be compared to the half of a hollow cylinder . . . bent upwards towards each end, and there terminated by final partitions—like nothing so much as a longitudinally split bamboo. . . . Alan Villiers has written: "I think the Chinese were the greatest of all Asian seamen, and their junk the most wonderful ship. Hundreds of years ago, the seagoing junk embodied improvements only relatively recently thought out in European ships—watertight bulkheads to isolate hull damage and so keep the ship afloat, the balanced rudder which makes steering easier, and sails extended with battens."¹⁰⁵

China has been the most nautical of nations, wetter longer than any other. With several thou-

War junks. Woodcuts from
Ming dynasty, c. 1522.



Junk

The word comes from Portuguese *junco*, cordage or rush, from Latin *juncus*, a bulrush. Rivermen are father to seamen. The rushes on the banks of their road worldwide were a natural caulking choice. The word then came to refer to worn out, unravelled cordage aboard that could be used for caulking in emergency, then to any old and discarded bit of trash, then to the vessels caulked. "The stone the builders rejected became the cornerstone." *Caulking* (q.v.), the least noticeable and smallest part of a ship was in fact its essence, what actually holds it afloat, the bones of the boat without which the most able seaman is fish food. As we have ever less per capita resource and more per capita waste, the judo of junk, creative garbage disposal, becomes an art of ever greater urgency. For that art, the junk and its seams provide a useful emblem. Junk life, and the central importance of bamboo in its traditions, is more relevant than may appear at first bounce of the eye. The boat people of China form a sizable portion of her population. Water villages were one solution to densities imposed on the Chinese earlier than we began to feel them in the West. Crowded conditions will impose a more careful scrutiny of water living in the West, just as increased transport costs will inspire an increased use of waterways. One of the most ancient and complex water living modes is the junk and its related rafts. Children particularly should be introduced to this water world from the infancy of nautical technology that still flourishes in the age of nuclear subs.

Bucky Fuller imagined tetrahedron archipelagos of floating towns stretched across

the sea routes as ocean inns and sea settlements; nodes of ocean routes as cities are the nodes of roads on land. A more immediately useful version of his vision would be water villages along navigable rivers of developing countries that use their banks and fluid acres as ingeniously and economically as the Chinese junk people have for centuries used theirs. With a handful of fuel, they cook a meal for a dozen people. Their survival designs deserve more attention in our crowded futures.

The shore and shore waters represent immense global acreage, considering all inlets and world rivers. Living on the edge of land becomes more common as land gets scarce. Chinese boat people and junk culture represent the oldest inhabited cultural design for shore survival. It should be included in the curriculum of all the planet's children from their earliest years, beginning with models in park lakes, the family tub, and the pond that deserves a place in any campus. Water should join reading, writing, and arithmetic in basic curriculum, survival on its edge a natural prelude to free roaming the oceans. Complete survivors are the issue of complete schools.

Worcester's *Sail and Sweep in China* is among those authentic books distilled over a lifetime from the blood of the author, well and amply illustrated with plans and drawings from his own hand, chiefly distinguished by the broad and compassionate sanity—as present on each page as his obvious, graceful command of the material. Ten thousand joss sticks should be lit in honor of this work of primary relevance for appropriate planetary design.

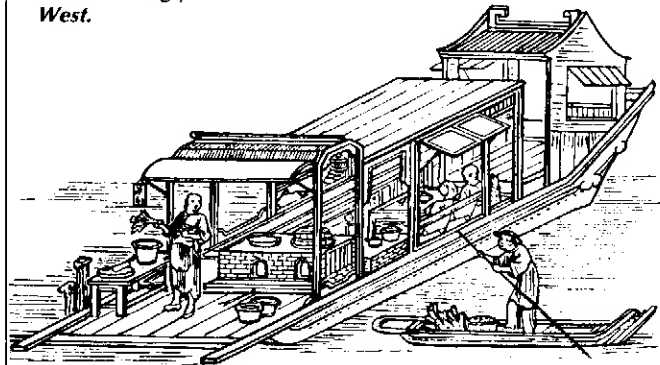
sand miles of seacoast, navigable rivers, and lakes, the Chinese became not only expert sailors engaging in complex naval maneuvers of more than seven hundred ships as early as the twelfth century, they also became a nation of "boat people," permanently living in floating dwellings. In Hong Kong alone there are over 250,000, and nearly every large city on the edge of water has overflowed onto it with houseboats:

"The Canton water roads are well known. Here boats are tied up to the banks of the river and to each other in regular rows, 'packed like the scales of a fish,' as the junkmen say, and constitute nothing less than a floating city. Lanes are left at intervals of twenty or thirty boats to facilitate communication. This is very necessary, for the nautical 'commuter' returning from work may, as likely as not, find that his floating home has moved to another 'street.' No phase of life is unrepresented among this population. Kitchen boats supply hot food at a low rate. The barber calls in a small sampan which he rows himself, calling attention by ringing a bell. The river doctor also gives notice of his approach by beating a drum; and, when his medicines prove of no avail, there are floating mortuaries.

"When he handles bamboo, the junkman's ingenuity finds its widest scope. He eats it in the shape of bamboo shoots, drinks out of it when it is made into a cup, sleeps on it when it is cut into bamboo shavings, which make excellent stuffings for mattresses. He uses it as a medicine and is finally carried to his grave by means of bamboo poles. Among a thousand and one nautical products for which it can be employed may be mentioned rope, thole-pins, masts, sails, net-floats, basket fishtraps, awnings, food baskets, beds, blinds, bottles, bridges, brooms, foot rules, food, lanterns, umbrellas, fans, brushes, buckets, chairs, chopsticks, combs, cooking gear, cups, drogues, dust pans, pens, nails, pillows, tobacco pipes, boat hooks, anchors, fishing nets, fishing rods, flagpoles, hats, ladders, ladles, lamps, musical instruments, mats, tubs, caulking materials, scoops, shoes, stools, tables, tallies, tokens, torches, rat traps, flea traps, back-scratchers, walking-sticks, paper, joss sticks, and rafts."¹⁰⁶

Up to 200 feet in length, junks are distinguished by off-center masts, as many as seven in number, which are oddly tilted fore and aft, giving a junk in full sail more the look of a slightly asymmetrical object of nature than the product of a rigid human geometry. The squared-off stem—like the

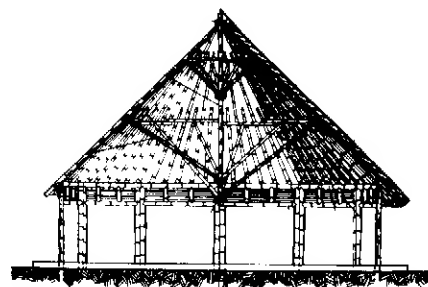
Floating kitchen. Centuries of survival by Chinese boat people provide models for the increasingly crowded West.



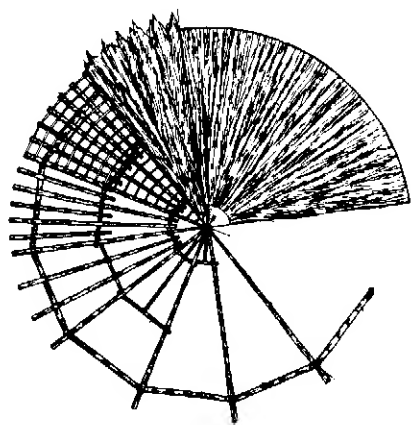
node of the bamboo culm that provided the ancient pattern for junk design—permitted a style of rudder steering of unparalleled efficiency that, unknown in Europe until the fourteenth century, was later adopted throughout the world. It permitted the Chinese to launch and manage larger ships earlier than any other people. War fleets are recorded in 486 B.C., and there was an expedition of two thousand ships in the first century A.D. (See Aero 1980.)

K

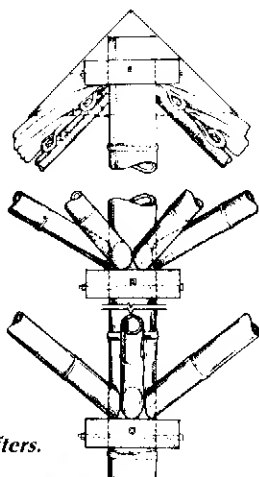
KIOSK. The kiosk is a round, thatched structure that takes fuller advantage of the physical properties of bamboo than any other shelter in the rural regions of western Colombia where a particularly durable species, *Guadua angustifolia* (q.v.), is used. The kiosk was originally a family dwelling, commonly 20 feet in diameter, its conical roof supported by a king post in the center. The walls were of *esterilla*, large bamboo board made by cracking culms at all nodes with ax blows an inch or so apart around the circumference of each node. A single long continuous crack is then made to open the culm, and the nodal diaphragms are removed. Bamboos 6–8 inches in diameter yield 18–24 inch boards cut to any desired length, which function as



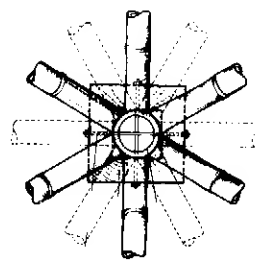
Kiosk.



Roof design.



King post umbrella rafters.



Kiosk umbrella framing seen from above.

hoops in a barrel to keep the columns around the circumference of the kiosk from being shoved outward at the top by the thrust of the rafter and roof weight. When the early kiosks were adapted, in time, for use as communal meetings and recreation, the walls were eliminated, for more light and easier access, and their structural function was assumed by peripheral strips of bamboo ringing the kiosk at the top of the columns, which are usually no more than 10 feet apart. Since the king post blocked vision and movement at ground level, its base was eliminated and an umbrella-like framing system was devised for the roof. Building a small model is advisable before your first full-scale kiosk. Hidalgo offers fairly complete details.¹⁰⁷ The kiosk is an excellent intro to architecture for young builders. Try a 6-foot diameter, 6-foot roof, hexagonal plan with columns 3 feet apart. For more on *guadua* architecture, see Chapter 5.

KITE. Kite tales in the Orient are plentiful and old since this art was flying in the clouds of China 2,200 years or so before the art of flying landed in Ohio with the Wright brothers in the present century. Kite use for military signaling was recorded in China around 200 B.C., and many early mentions of kites involve their use in war. One general, Han Sin, measured the distance from his troops to a besieged palace by flying a kite over it. From the length of the string, he figured his distance to the walls by simple geometry, dug a tunnel, and attacked successfully from underground. Another Chinese general of the Han dynasty (206 B.C.–A.D. 220) routed an invading army by flying kites with bamboo hummers over their camp at night. The weird sounds were taken for gods threatening the invaders, and they fled.

Around A.D. 1500, a large falling star was interpreted as bad luck by the soldiers of a Korean gen-

eral, who sneaked out the next evening and suspended a lantern from a kite. The kite light was taken as a positive omen by his soldiers who, full of confidence, routed their enemy the following day.

Warriors of the wind

A kite-fighting festival has been an annual event in Hamamatsu, Japan, since the 1500s. A sublimation for fists imposed by a ruler, according to one legend, these air battles now attract 2 million people each year. The kites honor first-born sons, who either touch the line as the kite rises or are kept strictly at home to avoid seeing their alter ego's dizzy altitudes, in the firm conviction that their presense would bring bad luck in the fight. A seventy-four-year-old participant: "I am still fascinated by the fresh greenness of bamboo and feel challenged to make a gallant kite." (Eliot 1977:555)



The Japanese often sent spies aloft by kites to scan enemy encampments, and Japanese thieves have taken the hint to break and enter from the air. One famous bandit stole the gold fins off dolphins atop a castle in Nagoya. Captured later, he was boiled in oil, and large kites were long forbidden in Japan. One Japanese architect lifted construction materials with large kites.

Fishing kites are used in Malaysia, where fighting kites—a highly developed form in many cultures—have been outlawed because the passionate contests led to such bitter disputes. Fighting kites have the string near the kite soaked in starch or glue and dipped in powdered glass. The trick is to jerk this stiff, sharp blade of string down quickly on the string of your opponent.

Although Marco Polo had reported seeing kites on his travels, their use reached Europe in the eighteenth century, not long before Ben Franklin's famous experiment with electricity in 1752. Flying a kite into a thundercloud with a wire replacing the string and a large house key fixed at his end, he got a sizable shock . . . and the idea for his subsequent invention of the lightning rod. As a child, Ben Franklin had managed to pull himself across a pond with a kite—a method of transport he suggested would work also in the English Channel. In 1903 box kites in fact did tug a boat the 20 miles across the channel from England to France.

Box kites were a notable breakthrough in kites designed by Lawrence Hargrave in 1893 (New South Wales). George Pocock had already applied the same principle to land movement in England, traveling as fast as 20 miles per hour in a two-kite carriage. Pocock was also among the first in the West to experiment with people-lifting kites. He flew his daughter up 100 feet in 1825; his son, 200 feet somewhat later.

Kites became sophisticated laboratories for some scientists, like Alexander Graham Bell, the inventor of the telephone, who built multicellular tetrahedron kites at the turn of the century to explore the aerodynamics of flight and apply these to airplane design. Orville and Wilbur Wright built a two-winged kite in 1899 with strings fastened to the tips to control flight, and they experimented with this as a steering device. In 1903 they incorporated their kite findings in the wing-bending controls of the world's first airplane. Their distinguished contemporary, Marconi, the inventor of the radio (1894), used kites to publicize his invention to an indifferent public. In 1901, he flew a kite from Newfoundland to pick up the first transatlantic mes-

The largest kites have been flown in Japan; they measure 50–60 feet across and require up to 200 people to launch.



sage—transmitted from Cornwall, England, to his kite-elevated aerial 400 feet up.

Meanwhile, across another ocean in Japan, kite fanatics were competing to get the largest possible monsters aloft. In 1906, a 5,000-pound giant built of 4-inch wide bamboo pieces, a round kite 60 feet in diameter and trailing a 480-foot tail, was flown by some 200 people. That, apparently, is the record for size.

The greatest altitude was reached in Germany, 1919, where a train of eight kites flew some 6 miles high (31,955 feet). The weight of the string limited altitudes greatly until 1749 when the Scotch doctor, Alexander Wilson, invented a train of six kites to fly thermometers cloud high in weather experiments. After this, kite trains were used by meteorologists throughout the world: seventeen U.S. weather stations used kites till 1933, after which kites were not used again for serious research until 1967 when the new airfoil or parafoil kites (invented in the United States by Domina Jalbert in 1964) were used to study weather inside a cap cloud above Chalk Mountain in Colorado.

In World War II, ancient oriental military uses of kites were resurrected by Germany. Triblade, motorless helicopter kites flew sailors above subs to scan the horizon for convoys to attack.

The tiniest kite on record is a 3-inch bow kite of balsa wood and tissue paper with a silk thread string, flown about 20 feet high by Clive Hart in New South Wales.¹⁰⁸

L	Lacquerware	landscaping,
	(plates, cups, boxes,	lanterns,
	trays, bowls),	lathing,
	ladders,	laundry poles,
	ladles,	levees,
	lamps,	light-bulb filaments,
	lampshades,	lofts,
	landing docks,	looms.

LACQUERWARE. Many products of bamboo lacquerware are intended more to be seen than used. They are curios not sufficiently durable for daily use. However, in Kyaukka, Burma, a fairly elastic

bamboo lacquerware is produced that is tough enough to withstand eight to ten years of rough daily use without dents or paint wearing off. It's unlikely that aluminumware would be without dents and scratches after a year or two of use in the average Burmese home, and furthermore the cups, bowls, trays, baskets, small boxes, and tiffin carriers of Kyaukka are far easier to wash than aluminum.

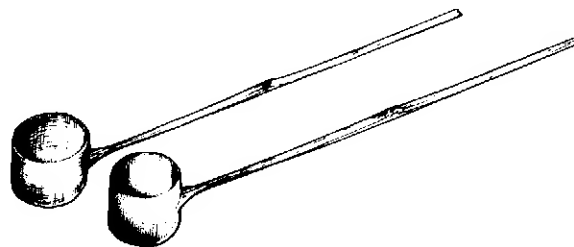
The manufacture of lacquerware begins with the bamboo skeleton. In Kyaukka, *Cephalostachyum pergracile*, preferred because of its great flexibility, is cut into convenient lengths, excluding nodes, and split radially into small strips.¹⁰⁹ (Radially split pieces are much stronger than those split tangentially.) A strip is bent into a circle, its ends tied together with thread, leaving an open portion where a second strip can be slipped in and bent into a circle. Its free end is similarly tied with thread. Strips are added in this way, with great skill and speed, in a spiral form until the desired shape is obtained. Next this bamboo base is coated with a paste made of a black oleoresin from the *thitsi* tree (*Melanorrhaca asitala*) mixed with bone ash. This forms a tough concrete when dry, which is vigorously rubbed with sandstone, a critical phase of the production that, properly done, greatly increases the lacquerware's durability. Finally, the inside only is painted with lacquer, the outside generally remaining black, with the resin and bone ash being well rubbed in with the hands. The pieces are then stored eight to ten days in a dust-free space until thoroughly dry.¹¹⁰

Kurz mentions lacquerware from Palembang so elastic it can be turned inside out without cracking or damage.¹¹¹ Plastic articles imply an economic leak from country to town, from less to more developed countries, from poor to rich. Lacquerware provides rural employment, uses local materials, decentralizes production, requires no complex machinery or heavy capital investment, and is a cottage industry that can reduce imports and increase exports.

LADDERS. These are a natural for bamboo, granted its aptitude for lightweight altitude. Hypereasy to handle, even up to 30 feet long, the two main pieces are usually wired together to keep the rungs in place. Cracks should be wired upon first appearance to prolong ladder life. Culms of larger species are also used singly as ladders, by making a triangular cut at the node. Kurz reports an ingenious bamboo ladder for climbing trees:

"Ladders for climbing lofty trees, especially for gathering fruit or obtaining beeswax, are con-

structed by means of bamboo pegs driven into the trunk. These pegs are made of old thick bamboo, split to about 2 inches wide. Each is cut above a joint, which forms a solid head to bear the blows of the mallet, and the point is flat and broad, cut away carefully to the siliceous outer coating. To the head of each is strongly tied a strip of the rough rind of a water plant. The climber carries forty or fifty of these pegs in a basket by his side and has a wooden mallet suspended round his neck; he has also prepared a number of strong, but slender bamboos, each 20 to 30 feet long. One of these he sticks firmly in the ground at the foot of the tree, and close to it; he then drives a peg as high as he can reach, and ties it firmly by the head to the bamboo. Climbing up on this, he drives in and ties successive pegs, each about 3 feet apart. He soon reaches the top of his pole, when another is handed up to him, and being bound to the one below, he ascends in the same way another 20 feet. When his pegs are exhausted, a boy brings a fresh full basket up to him, and a long cord enables him to pull up the bamboos as he requires them. This mode of ascent looks perilous, but is in reality perfectly secure. Each peg holds as tightly as a spike nail, besides which the weight is always distributed over a great number of them by means of the vertical bamboos. The same mode prevails in Java, amongst the Nagas of Eastern Bengal, and the Karens of Burma."¹¹² Tree-house architects and apprentice monkeys, ponder well.



LADLES. Many shapes and sorts are made of bamboo. For a water ladle, the cup is cut just above a node, to the desired size, a hole carved into it, and a handle fitted. Since the ladle lives in water, no glue is needed to bind the pieces that compose it. The bamboo swells to seal the joint: Its glue is use.

LAUNDRY POLES. Bamboo poles are run through the sleeves of shirts or dresses and stuck out the window as drying racks. "This is especially convenient for boat people as well as villagers who live over their shops."¹¹³ Leaving the stub of a branch on at one node gives a convenient support for a clothesline.

LIGHT BULB. The world's first light bulb, over a

century old, still burns with bamboo in the Smithsonian Institution in Washington, D.C. "In the process of inventing the incandescent lamp, Thomas Edison confronted a difficult problem—finding the appropriate material for a filament. In 1880, he learned that finely shredded bamboo serves as a firm support for round hemp palm leaf fans. Taking his clue from this hint, he collected all available varieties of bamboo from throughout the world, including Southeast Asia and Japan. After repeated tests, he ascertained that a variety from Kyoto would best serve his purpose. In 1882, he set up a company to produce incandescent lamps from the filaments of Japanese bamboo and illuminated the nights of New York."¹¹⁴

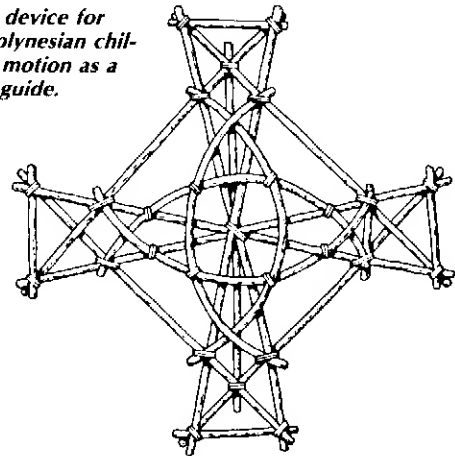
M Marimbas, medicines,
 markers, mills,
 masts, mobiles,
 mattangs, mushroom culture
 matting, houses,
 mattresses, musical instruments.

MARKERS. "The U.S. Department of Defense even found bamboo ideal for use as markers on the Greenland icecap. It happens that metal poles placed in the ice are warmed by the sun and sink out of sight. Bamboo does not conduct as much heat and so stayed where it was put."¹¹⁵

MATTANGS. Here is a seaschool visual aid. Throw a bean into your bathtub, or a pebble into a pond, and watch the ripple pattern produced. Objects that break the water surface—a brick set up in your bathroom experiment, an island in real sea—alter this pattern in learnable ways. Pond or Pacific, wave motions obey the same principles of liquid mechanics. The study of these patterns was developed to a highly refined science-art by the Polynesian peoples some three thousand years ago in the course of colonizing migrations that in time settled almost every island in the Pacific, and they remained in touch as a cultural entity across vast seascapes so effectively that even today a Maori of New Zealand can stretch his native tongue to the Hawaiian islands and remain understood. In the nineteenth century, captains of Western ships were still losing themselves in brief 150-mile voyages between islands in the South Pacific, their vessels equipped with all the instruments of the most up-to-date navigation and charts.

For millennia before them, the Polynesians in pairs of 60- to 80-foot dugout canoes fashioned with tools of shell and bone, lashed together with a deckhouse between of bamboo or other materials, had found their way by reading the map the sea

Mattang, a device for teaching Polynesian children wave motion as a navigation guide.



was constantly generating of its nearby islands in the motions of its waves. It was a braille of the whole body: they would not merely *look* at the waves but crouch in the hull of the bow as close as possible to the most precise device for navigation they had discovered, the ocean's motions, and *feel* wave patterns bouncing off islands 100 miles away. Map and medium, sailor and tool of his trade, were one. The visual aid to teach this teletactic art to child sailors of the crew was the *mattang*, a simple web of bamboo strips or branches providing a codified summary of possible wave patterns. The gradual mastery of this code of tribal memory graven in bamboo permitted them in time to navigate by touch and teach the art in turn to their children, bound for islands none of them had ever before felt quivering their locations to their skins as they listened in the bottom of their boats.

"Miniaturization" is the term Bucky Fuller used to describe the gradual decrease in matter and increase in organizing mind that marks technological evolution. The dramatic Alice-in-Wonderland shrinkage from early crystal sets to transistor radios was, for Fuller, a useful example of this process in his own time. Following this trajectory, we can imagine a technique of such density—that it disappears. Some "primitive" technologies appear less "advanced" to civilized peoples bristling with instruments to lug about precisely because the human body-mind had become such a subtle master of its own capacities that no other equipment was required. This is certainly the most appropriate technology we can evolve towards, however, because it's available to all without investment in additional accessories to burden the equipment possessed already by each owner-in-residence, the local human, floating in his bag of skin, full of blood perception, and inventive energy.

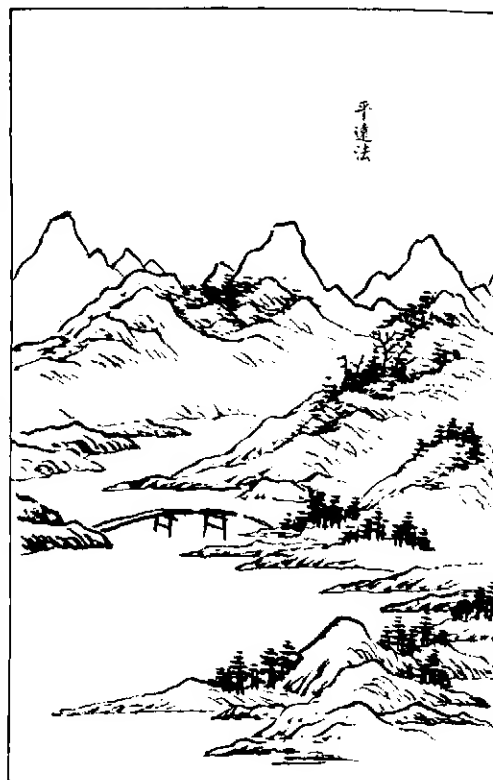
When we can feel history approaching as far off as seabums in the primitive Pacific could feel the distant beach, we will find kinder harbors as well and sail, with less costly equipment, more significant seas.

MEDICINES. "The Chinese used bamboo medicinally as a tonic for the stomach, as a cure against dysentery, and as a remedy against toothache. When medical opinion proved in doubt, they would explode it in fire to drive any demons away."¹¹⁶ Coughs, asthma, cancer, eye ailments, and paralytic complaints were also treated with various preparations from the plant, as was a sluggish love life and hair and skin problems. (See *tabasheer*.)

MUSHROOM CULTURE HOUSES. "Some 20 million poles of Makino bamboo (*Phyllostachys makioni*) were used in the construction of 6.8 million square meters of mushroom culture houses. The poles were treated with PCP-sodium salt, since creosote-treated bamboo is unsuitable for this purpose. Poles so treated last around five years, two to three times as long as untreated ones in this industry."¹¹⁷

MUSICAL INSTRUMENTS. "The two most characteristic acoustic features of the music of the Chinese culture area (extending from Korea to Indonesia) are the high proportion of chime-idiophones and the prominence of the bamboo plant (and the pitch pipes derived from it)" (Needham iv.3:142). From North Korea to northern Australia is a sweep of latitudes equaling that from Vancouver, Canada, to Lima, Peru, in our hemisphere. Roughly half the people in the world live there. Music is a central part of their life, and bamboo is a central part of that music. Its eminence is ancient, recorded in the oldest surviving classification of instruments we have in the world. Over four thousand years ago in China, under the Emperor Shun (2225–2206 B.C.), instruments were divided into eight materials, each with a corresponding cardinal point of the compass, a season of the year, and an element of nature represented by one of the eight trigrams of the *I Ching*. Bamboo was associated with pipes and the east, the direction of the rising sun, which linked it naturally with spring, when culms are rising with all the thrusting energy of the sun itself. Among the elements of nature, bamboo was associated with the mountain, where temperate, monopodial species have especially been at home because of their preference for a moist but well-drained soil.

The mountain was the "youngest son" in the family of hexagrams, associated with the end of movement, tranquillity, keeping still. Home of her



sages and hermits—the most respected members of Chinese culture—subject of her favorite paintings, forming an element in her most basic concepts such as *yin* and *yang*, the mountain for the Chinese was not simply a hunk of rock but a revered and animate being. Bamboo's identification with it was an honored one, no less significant than the plant's link with spring and dawn, the most vigorous season and hour.

This vigor has given bamboo a long history as a martial instrument or club whose rhythms have stirred many a land and bruised many opponents. The *shakuhachi* is sometimes described as the only musical instrument in the world that doubled as a weapon. But on the island of Trinidad in the Caribbean, bamboo also evolved as a weapon-instrument to replace prohibited drums. When the bamboo stick bands were in turn outlawed in the late 1930s, the people—whose invention is often a co-function of oppression—evolved the steel bands whose engaging rhythms have since spread throughout the world.

Briefly, the pre-Lent Carnival ("farewell, flesh," from Latin) was introduced to Trinidad by French planters in an upper-class format in the late 1700s. The slaves out back of the Big House had their version, too, which came out of the closet with liberation in 1837. "Masks allowed action

without fear of reprisal. Bands grew larger and louder. Songs were purposely lewd and pointedly anti-upper class. The planters were horrified. Police tried to squelch Carnival with little success . . ." Church propped up State to hold back the blacks: "The original slave celebrations had moved to the beat of the congo drums—the same drums used in religious rituals to summon believers to worship and gods to receive sacrifices. The official church, as part of its drive to eliminate 'foreign' religions, outlawed the drums. But no celebration in Trinidad works right without rhythm. 'Bamboo tamboo' stick bands were devised to fill the musical gap." The bands were hundreds of young people, a roaming rhythm section whose music proved so potent it was outlawed by the police. The people, musically stimulated, would take no sass from the brass, and had several hundred heavy-duty clubs in their orchestra to back their will.¹¹⁸

The Dutch had a similar problem with popular music in West Java, which is a bamboo musical center with over twenty different percussion, wind, and string instruments as ancient as they are ample. The *calung* and *gambang* are carved in stone in the eighth century temple in Borobudur, and bamboo instruments predate Hinduism in Java. Their development is supposedly closely related to the pre-Christian Polynesian migration. "The Sundanese used bamboo instruments in honor of Dewi Sri, goddess of rice and agriculture in Javanese mythology. The melodious sounds of the slender, gracefully constructed instruments express well the cheerful character of the Sundanese people."¹¹⁹ The *angklung* is a bamboo percussion instrument that originated in West Java and is now known round the world. Two, three, or four bamboo pieces, usually tuned to as many octaves, closed at the bottom by a node, have three-quarters of their circumference removed to about half their lengths to form a sort of tongue by which they are hung vertically, their lower ends sliding horizontally in a slot in the bottom of the bamboo frame. When shaken, "the sound is curiously bright. The air column in the tubular part of the mobile bamboo segments produces, when blown, the same tone-pitch as shaking the entire segments."¹²⁰ The Baduy of South Banten still shake three or four *angklungs* when ending work on the sacred arable land. Anciently an instrument of farming festivals, it was also used to rouse soldiers and was suppressed as such by the Dutch for fear it would inspire revolt against colonial power. By the 1920s it had become merely a child's toy, used by beggars in the 1930s to attract

a coin. A musician from Bandung then began an *angklung* renaissance, incorporating Western-style music and modern arrangements with local traditions: Hybrid vigor.

Java and the surrounding islands of Indonesia is an area rich in its variety of bamboo instruments. A few among them: The *calung* of West Java is made of twelve, fourteen, or sixteen bamboo tubes closed by a node at one end, with a diagonal cut at the other, tied together with cords like a rope ladder. From top to bottom, tubes get bigger and lower in pitch. The top is hung from house or tree; the lower end tied to the left knee of a sitting player or to the waist of one who is standing. It is "beaten with two *penakols*, sickle-shaped wooden sticks of slightly different sizes."

The *gambang bambu* evolved recently from a wooden version, "the Sudanese counterpart of the Western piano." Bamboo tubes are tied horizontally together by cords on a bamboo platform and played like the *calung*, which the *gambang* resembles but with more tubes. A similar instrument—with different music—is played in North and South Celebes.

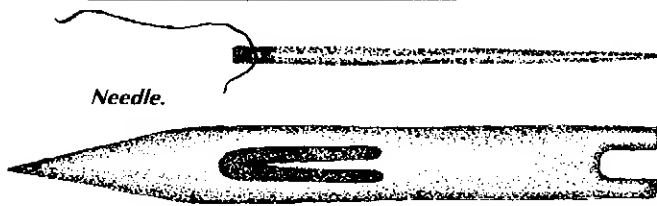
The *rengkong* is one long bamboo pole, carried on the shoulder of a dancer, with bushels of newly harvested rice hanging from each end by split bamboo strings. It is played in a ceremony to Dewi Sri, the Javanese goddess of rice and agriculture, after a poor harvest. "The rhythmic movement of the dancer's steps causes the suspended rice to swing, and the friction of the string against the bamboo produces the characteristic musical sound."

The *kohkohl* is a complete internode with a slit along one side beaten with a soft wooden stick. The sound is determined by the length and diameter of the bamboo tube and the width of the slit.

The *hatong*, a panpipe, is usually played in pairs—a large one with two or three tubes and a small one with ten to fourteen small tubes. Three different sorts are used in stag hunts to communicate among the hunters, with one, two, and three pipes, respectively.

The *kolecer* is a weathercock, with propellers attached to various size tubes. A number of different sizes are set out to produce as many notes.

The *celempung* is the Sudanese bamboo string instrument, "a complete internode closed at ends by nodes, provided with a long slit and two bamboo strings cleverly split from the slit. This instrument is widely distributed and can be found from Madagascar, Vietnam, Malaya, and all over Indonesia to the



Needle.

Netting needle.

Tasadays in the Mindanao of the Philippines. Each area normally has a characteristic number of strings, varying from one to four."¹²¹

Musics of Many Cultures and *Music of the Whole Earth*, both one-volume efforts to sum up the globe of music which we are, contain many references to bamboo.¹²²

- | | |
|----------------------------------------------------------|----------------------------------------------------|
| N Nails,
napkin rings,
net floats,
nets, | netting and sewing
needles,
<i>netsuke</i> . |
|----------------------------------------------------------|----------------------------------------------------|

NAILS. "Limaye [1943] found that bamboo nails [more strictly, pegs] hold as well as iron nails, although the bamboo nails require predrilling of the wood."¹²³

NET FLOATS. Bamboo's natural bouyancy, which inspired sealed compartments in Chinese ship design, also makes it a natural for net floats. Oshima (1931) mentions huge nets requiring a thousand culms each of moso (*P. pubescens*), the giant of temperate bamboos (70 feet by 7-inch diameter), with culms noted for their gradual taper.

NETSUKU. "Netsuke were the decorated objects men wore on one end of the cord by which a small box for writing materials or medicine called an *inro* was suspended from the formal Japanese belt."¹²⁴ Netsuke and brush pots were among the objects most favored by oriental bamboo carvers to demonstrate their amazing virtuosity.¹²⁵

- | | |
|-----------------------------------------------|---------------------------------------------------------------------|
| O Organs,
ornaments,
outriggers, | ox cart beds (sides,
yokes),
ox goads,
oyster cultivation. |
|-----------------------------------------------|---------------------------------------------------------------------|

OYSTER CULTIVATION. "In shallow coastal waters in some areas around Taiwan, extensive bamboo racks have been built for oyster cultivation. The yield of oysters raised on rayon lines attached to these racks can be ten to twelve times the yield by the conventional method of driving bamboo splits directly into the ocean floor."¹²⁶

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P Packaging,
paper cutters,
paper pulp,
pegs,
pen and pencil
holders,
pens (ink and animal),
pillows,
pins,
pipes (drain, gas,
irrigation, opium,
organ, tobacco,
water, and so forth),
plant labels (shades
and stakes),
plates,
plybamboo, | poison,
poles (boat, carrying,
clothes, flag, fishing,
fruit picking, garden,
punting, telephone,
tent, TV, and
vaulting),
polo balls,
polo mallets,
posts,
pots,
printing pads,
propellers,
props (for banana and
various trees),
punishments. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

PACKAGE TACTICS. Japan, as a small island, entered the experience of population densities and consequent resource crunch earlier than most of the cultures on the planet, which discovered much later that all earth is an island. Increased precision and efficiency of design were the necessary cultural adaptations to these denser conditions, and bamboo provided the raw material for centuries of cultural experiment. The Japanese traditions of craftsmanship and patient addiction to detail ripened slowly around bamboo, and the delicate skills fostered in the production of fans, flutes, tea whisks, and dozens of delicate bamboo artifacts found expression in the twentieth century design of electronic circuit boards. More omnipresent, so generally less visible and considered, are the packaging traditions of Japanese culture.

How one person makes one package is a small matter, but the package tactics of an entire culture can determine the use of sizable resources and generate enormous trash. Industrial cultures apparently prefer dirty lots and national parks full of old plastic, bent aluminum, and broken soda bottles to the work of considering more frugal and tidy alternatives of package design. America created her habits growing up as a spendthrift young culture with plenty of wilderness, a colossal backyard where you could get more or dump the ugly. But Japan evolved as an island culture. This means limited resources, so don't waste. Make it well, make it to last, make it small and neat. Design multiple use of one space or one object, and remember that unvarnished simplicity, the grain of natural objects, is often the grandest ornament.

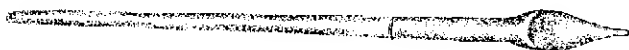
Japan's traditional packages were therefore carefully designed of local materials, renewable and biodegradable resources that sank back into the earth they were thrown upon. Bamboo was

Possible planet pen

The cheapest, oldest, and most widespread pen in the planet village is also the most possible as a planetary norm in the global schoolhouse of modern universal education. Bamboo or reed writing pens have been used in Jordan since 3000 B.C.

One end of a piece of dry bamboo roughly 6 inches by $\frac{3}{8}$ inch by $\frac{3}{16}$ inch is whittled to desired width for fine writing or bold block lettering, then shaved down to a flexible point formed by the durable outside skin. The end is cut straight across, then shaped to your personal writing angle by writing gently on sandpaper—without ink. Drill a hole roughly $\frac{3}{32}$ inch in diameter about $\frac{1}{8}$ inch from the point to serve as a retaining hole for ink. A plate can be added for less frequent refilling.¹²⁷

Pen.



more widely used than any other material. The sheath wrapped countless pastries, candies, fish, and soybean lunches; 6-inch culm sections served as jars for soy sauce or delicacies like pickled mountain burdock roots. Dozens of liquid or semi-liquid dishes and sauces were transported home in bamboo containers—which then were used around the house as jars and small buckets after whatever came in them was gone.

Miniature bamboo objects became the trademark package of different areas. Small boxes of bamboo leaf over a frame of split bamboo; model boats, houses, and hats of sheath or leaf and bamboo strips; bamboo snowshoes filled with vegetables pickled in soybean paste; tiny mats and baskets in the style characteristic of the region producing the treat inside—the package evolved from a functional wrapper to an object in its own right.

Photographs of traditional Japanese packaging in bamboo and other materials are beautifully packaged in *How to Wrap 5 Eggs* (Oka 1975).

PLYBAMBOO. Japanese researchers found that bamboo fibers have a lamellar structure in which seven to nine fiber layers are alternately parallel and perpendicular to the axis.¹²⁸ Bamboo-fiber anatomy, therefore, anticipated the basic structure of plybamboo, whose early use was explored in eleventh century China as vanes for rotary winnowing machines. Modern processing of plybamboo is well

developed in a number of oriental countries. Here, from India, is how to make your own:

Bamboo mats are woven from strips, dried, treated with phenol formaldehyde resin (alcohol soluble), conditioned and pressed in a hot-press at temperature of 150°C and pressure of 28–35 kg/cm². Duration of pressing time depends on product thickness: board can be prepared from single or multi mats. Veneers, veneer mats, sawdust, shavings, etc., can be used as core material or faces in board production. Boards can be made also in corrugated form. Stringer type boards can be made using a mould and mandrels. Bamboo boards can be used as light partitions or ceilings, for production of moulded furniture, attache cases, suitcases, table tops, chair seats, windmill blades, etc.¹²⁹

Investigations were carried out in the Composite Wood Branch at Dehra Dun (India) Forest Research Institute, and the process has since been patented (Indian patent No. 42228). Plybamboo boards were used in all parts of test houses built at Dehra Dun. Panels buried seven years were dug up still sound.¹³⁰ Plybamboos offer the plant's abundance in a format convenient for industrialized mass shelter. Their use will probably claim a progressively large share of the world's bamboo harvest. Experimental use should be high priority research in all ministries of housing in countries with significant bamboo reserves. (See Chapter 4, pp. 96–98, for more on laminated bamboo.)

POLO BALLS. "Polo balls are made in India from the hard, even-grained rhizome of a common species of *Dendrocalamus*."¹³¹

POTS. "People in the jungle can use the internodes of any large bamboo as a pot in which to boil water or cook food, as the cooking has finished before the green stems burn through."¹³²

PROPS. A large volume and common use of bamboo in many parts of the world is for cheap, light, easily made and transported props. *Bambusa vulgaris* was used to prop bananas for many years by United Fruit in Central America, and this use is one of a number of rapidly expanding bamboo industries in Taiwan, where islanders with limited space are multiplying shrewd uses of bamboo's rapid altitudes. "Four bamboo treating plants preserve banana props with creosote, with a volume growing from 1.5 million poles treated in 1971 to about 3 million in 1973. Cultivation hasn't kept pace with

use, so green poles have risen around 30 percent in cost. Treatment began around 1966 by the open tank method, later by the Bethell process (90°C, 14kg/cm²).¹³³

PUNISHMENT. "In a fearful punishment, formerly used in Bali, the criminal was strained horizontally over the young growing shoots of a bamboo stock, of which the longer halms have been removed. As they grow quite rapidly, the very hard silica-rich shoots pierce through the unfortunate sufferer."¹³⁴ A cruel and unusual punishment involving bamboo is told of the tyrant Kao Yang (A.D. 550–559) who forced prisoners to attempt flight from a 100-foot tower: "On one occasion the emperor visited the Tower of the Golden Phoenix to receive Buddhist ordination. He caused many prisoners condemned to death to be brought forward, had them harnessed with great bamboo mats as wings, and ordered them to fly down to the ground. This was called a 'liberation of living creatures.' All the prisoners died, but the emperor contemplated the spectacle with enjoyment and much laughter."¹³⁵

"Under the Chou and Han dynasties, convicted criminals could look forward to either: being branded on the forehead, having their noses cut off, maiming, castration, or death. . . . later times these pleasantries were amended to: bambooning, bastinadoing, banishment, exile, and the ever-popular death (choice of strangulation or decapitation)."¹³⁶

A Victorian traveler, Colonel Barrington de Fonblanque questions, "What would a poor Chinaman do without bamboo?" The thatch of his house, mat where he sleeps, cup for his drink, chopsticks to eat sprouts of the same plant, pipe to water his crops, rake, sieve, and basket to harvest, clean, and carry them, the mast of the junk for boat people, pole of the cart on land—all of bamboo . . . and if he strays briefly from this path of civil virtue: "He is flogged with a bamboo cane, tortured with bamboo stakes, and finally strangled with a bamboo rope."¹³⁷ The colonel neglects to mention the funeral procession that follows, customarily led with—a spring of bamboo.¹³⁸

The colonel is mercifully silent as well about the public and private use of bamboo poison. In a

special part of a special bamboo, "there is a poisonous secretion extremely irritating to the throat and nose, causing itching which brings on a bad skin infection. This has been known to the Chinese for a long time, for the poison was formerly used in criminal cases. A drink was prepared for the condemned. Death followed, but not before much agony had been suffered. This bamboo is not planted near wells."¹³⁹

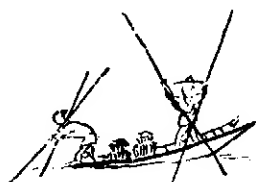
R	Racks	instruments),
	(for curing and	reinforcement (for
	drying food),	concrete and
	rafts,	adobe),
	raincoats,	rings,
	rainpouts (and	ritual objects,
	guttering),	roofing,
	rakes,	ropes (towing, drilling
	rattles,	salt wells, hoisting
	rayon,	brine),
	record needles,	rug poles,
	reeds (for woodwind	rulers.

RACKS AND TRAYS. "Those of bamboo are used in almost as many ways as baskets. Bamboo racks, baskets, and trays constitute important items of equipment required for many large-scale industrial and commercial pursuits in the Orient. In the silk industry, the mulberry leaves are brought from the field in bamboo hampers, while the silkworms are hatched and spend the whole of the caterpillar stage on bamboo feeding trays. As a fitting finale, they are placed, when mature, upon racks fashioned from bamboo in a form suggesting treetops where, in the wild free state, their ancestors spun their cocoons. The shape of these spinning racks is cleverly designed, however, in deference to the requirements of space economy."¹⁴⁰

RAFTS. In Colombia and Ecuador, large rafts of *Guadua angustifolia* deliver this bamboo to markets and formerly were a principal means of transport for people and mountain agricultural produce. Since bamboo grows well along rivers, the most natural and ancient means of transporting it has been to float it downstream. In the Orient, up to ten thousand culms may compose a single raft of bamboo, which is generally considered the archetype of all Chinese vessels:

A length of bamboo cut in half longitudinally and floated on water gives a striking model of the constructional principle of all Chinese craft. It is not necessary to insist upon the sea-going bamboo sailing raft of Taiwan as the only ancestor of all junks, for many other forms of

Punting poles. A preferred species is Bambusa tuldoidea.

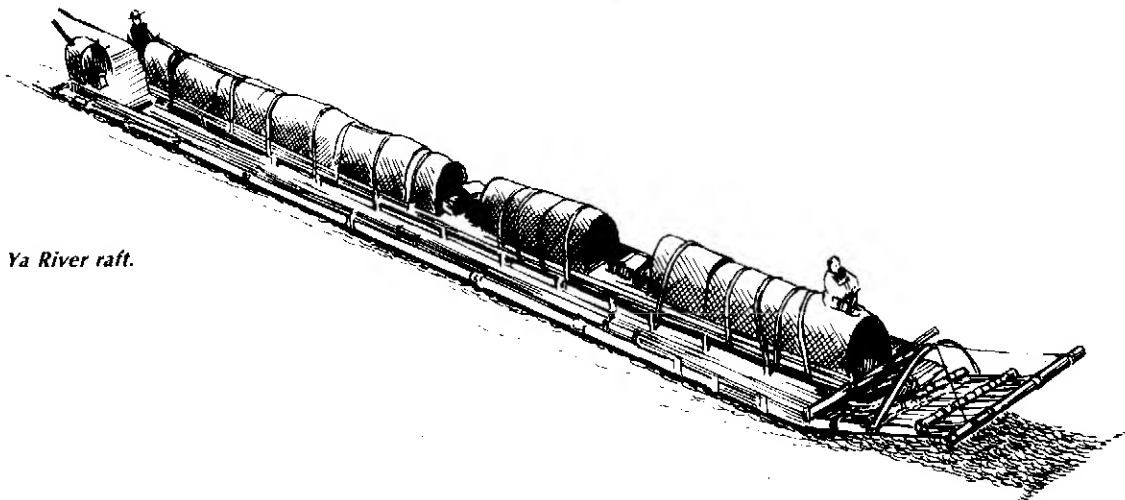


bamboo raft are regularly using Chinese rivers at this day. One of the most interesting is the Ya River raft of Szechuan, which moves both up and down 100 miles of intractable waterway between Yachow and Chiating, carrying Tibetan trade. This *Chu-fa chhuan* must be one of the lightest draught general cargo-carriers in the world, for its depth below the waterline when loaded (with a cargo of 7 tons) is often as little as 3 inches and never exceeds 6, owing to the buoyancy of the bamboos. In length the rafts, which are quite unsinkable, vary between 20 and 110 feet, and are built throughout of the culms of the giant bamboo *Dendrocalamus giganteus*, which grows as high as 80 feet with a diameter of as much as a foot. The bow is narrowed, and bent upwards in a curve by heating, so that the raft can slide over rocks which may be almost level with the water surface.¹⁴¹

Worcester (1966:113-5) provides interesting details on the history and construction of the Ya

River raft, with a photograph of a model (plate 12) from the London Science Museum's collection of twenty-seven models of bamboo and wood rafts, junks, sampans, houseboats, inflated skin rafts, trawlers, lifeboats, etc. (137-8).

Emperor Wu Ti (140-86 B.C.) built a floating castle 600 feet by 600 feet, garrisoned by two thousand men and some cavalry horses as well. Floating villages with room for two hundred families were reported by a seventeenth century official of the Dutch East India Company. (Cf. Rudofsky's valuable *Prodigious Builders*, 146, 373.) As the floating life becomes more common in a more crowded world, China's long history of buoyant architecture will be more consulted. More attention will be paid to bamboo's role in river transport and shelter, to its place in bankside industries of paper pulp and plybamboo, and to its help in holding banks stable against the constant current. (See *junks*, above.)

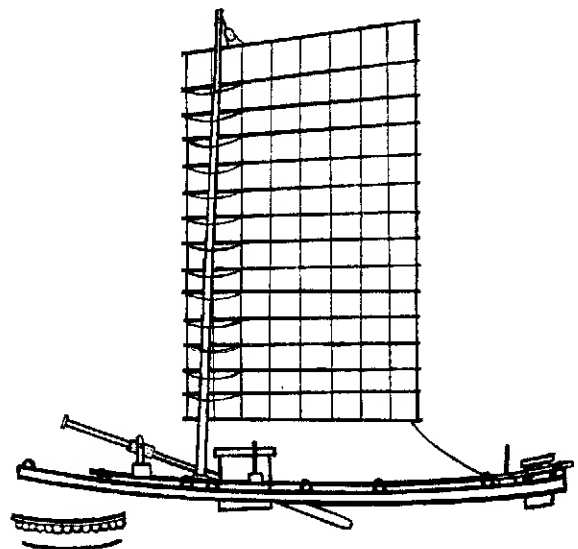


Ya River raft.

The tray boat of T'ai Wan. These boats are simply small rafts, measuring 12 to 40 feet long, with a draught of a few inches, built of about a dozen large bamboos lashed together with the tapering ends forward. The foremost end of the raft is narrower and more upturned than the after end.

The culms used grow to a height of about 60 to 80 feet with a maximum circumference of 17 inches. This species has a large core and is an extremely light wood. The bamboos are very carefully selected, for they must be of uniform size. To prevent cracking and to reduce

weight, the siliceous skin is removed, and the nodes are hardened over a slow fire. The raftmen say that this method of treatment also increases their "arresting power" when afloat. A vain effort to keep out the water is made by securing a small bamboo between each of the larger ones and its neighbors. Across the fore and aft poles eight slightly smaller curved poles are lashed athwartships at intervals to suit the construction. The after ends of the main bamboos, which are usually, though not always, broader than those in the bow, are painted red, black and green.



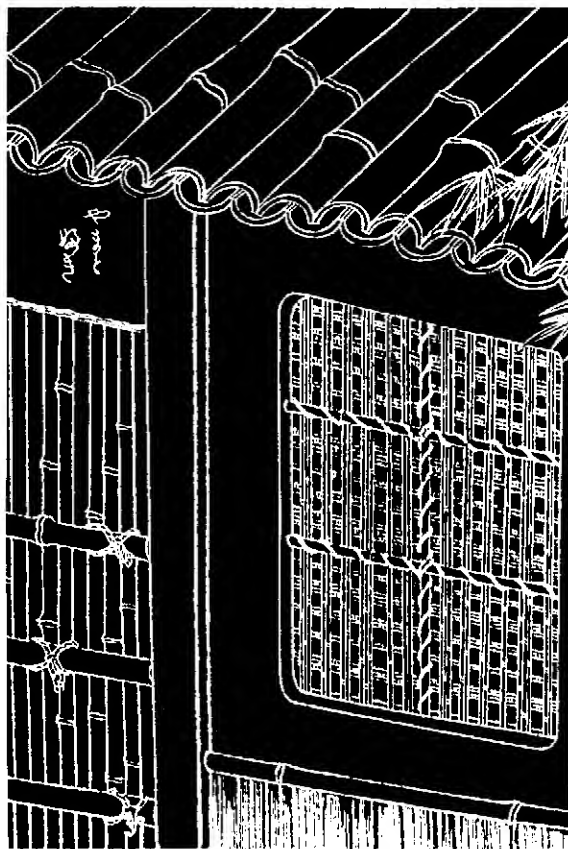
RAYON. A bamboo rayon factory in Pakistan produces more than 5,000 tons of high quality rayon a year with technical assistance from Japan.¹⁴²

RECORD NEEDLES. "Very satisfactory phonograph needles have been manufactured from bamboo slivers. They are heated in oil at 340°F and tumbled in barrels containing sawdust, which removes excess oil and polishes the slivers. They are then ready to be pointed and used."¹⁴³

RITUAL OBJECTS. "As well as being a food, the shoot, like the culm, may house a god under certain conditions. In the valleys among the Chekiang hills between rice fields one often passes small shrines in which instead of the accustomed idol one sees a dried bamboo shoot. On examination, this shoot reveals very unusual characteristics. The most noticeable are the oblique joints which give a zigzag effect. It has been found that occasionally in a grove of *Phyllostachys pubescens* (*mao chu*: 'hairy bamboo'), which is very common in this region, a shoot comes up with this freak characteristic. The Chinese are quick to discover it and because of its strangeness they think it possessed of preternatural powers."¹⁴⁴



Roofing of split bamboo culms reportedly inspired the first clay tiles. Japanese woodcut.



ROOFING. Shingles, thatch, and tiles. "In the dry zone around Mandalay, split bamboo may be woven into long narrow mats which are put on the roof like overlapping shingles. In some other places bamboos with diameters of 3–5 inches are split in half lengthwise, cut into two-foot sections, and laid on the roof like Chinese tiles."¹⁴⁵

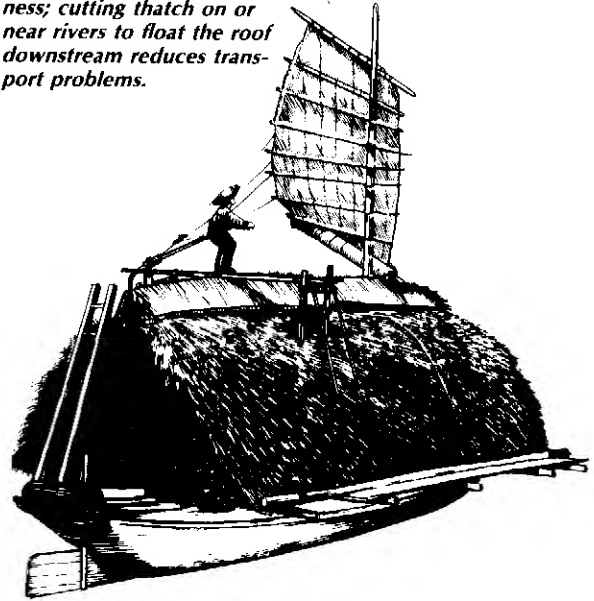
The earliest type of roof material was no doubt the fully grown hollow bamboo stem split in half longitudinally, convenient lengths being then laid in rows with the concavities alternately facing outward and inward. (Bamboo and reed matting must also have been used from high antiquity, and still frequently forms the covering for sheds and boats.) This very corrugated arrangement was afterwards carried out in half-burnt grey tile¹⁴⁶

Thatch of sasa bamboo leaves is said to last a long time in Japan. Tsuboi recommends late August harvest there: "if gathered while the leaves are tender and green, they will decay quickly."¹⁴⁷

- S** Sailcovers,
sails
sailstays,
sake,
salt well drilling,
sandals,
scaffolding,
scales,
scarecrows,
scoops,
scratchers for backs,
screens (room
dividers,
papermaking),
scrubbers,
sedan chairs,
shades,
shakuhachis,
shavings (for pillow
and mattress stuffing
and for caulking for
boats),
sheaths for knives and
swords,
shields,
shingles,
ship design,
shoehorns
shoe soles,
shoots for food,
shovels,
shuttles for weaving,
sieves,
silk industry,
skewers for cooking,
ski poles,
slide rules,
sluices,
snow fences,
spears,
splints,
spouts for watering
cans,
spray guns for citrus
insect pests,
springs (for carts,
toys, gates),
stakes,
staves,
sticks (incense,
rhythm, roasting for
shish kabob),
stilts,
stools,
string,
sugar,
sunning floors for
drying coffee and
other produce,
swimming pools.

SAILS. Bamboo mat-and-batten sails are unique to Chinese area ships: "The sail is made by weaving together thin and narrow strips of the outer parts of the stems of bamboo and is divided into sections grasped by bamboo battens. Thus the sail falls in tiers, ready to be hoisted. A large mainsail in a grain ship needs ten men to hoist it, but for the foresail, two suffice."¹⁴⁸ The widespread use of bamboo matting sails necessitated this form of frame and led naturally to the balance lug shape. The aerodynamic importance of tautness is considerable; yet such a design, which doubtless arose because of the easy availability of a material so light and at the same time so strong, never arose in any other culture. The battens have at least five other uses: they permit precise and stepwise reefing; they allow immediate furling of sail, which falls into pleats; their setting system obviates the need for cloth or canvas as strong as on other sails; and they act as ratlines, giving access for the crew to any desired part. Above all, they are a complete protection against tearing and carrying away; a Chinese sail may have half its surface full of holes and yet draw well. The sail never jams. As Audemard thought fit to emphasize, this system "avoided the sending of men aloft to take in reefs, always a dangerous operation in bad weather."¹⁴⁹

Thatch boat in China. Building is a bulky business; cutting thatch on or near rivers to float the roof downstream reduces transport problems.



The sail is stiffened by battens of bamboo, each of which connects with, and indeed forms part of, the sheet, thus keeping the sail very flat: this, then, is the secret of the Chinese sail. In seagoing vessels and in craft used in very open inland waters the sail is peaked. In narrow waters it is flat-headed, narrow and very tall, so as to catch the breeze over the banks of the river, creek or canal.

The sail design of junks could be a technology appropriate in areas presently ignorant of it but blest with small navigable waters and bamboo. Building models of a junk is an interesting exercise for schools. Bamboo sails have also been used traditionally in windmills (q.v.).

SAKE. "A sake can be brewed from bamboo seed, which though rather sharp to the tongue does not otherwise differ from ordinary sake."¹⁵⁰

SALT WELL DRILLING. This is one of a number of industries that would virtually come to a halt without bamboo: "Possibly there is no more indispensable article in China than bamboo. One missionary made a list of bamboo uses, unfinished with 440 separate uses. If it were uprooted from the soil of China, it would be worse than losing a right hand. So many and varied are its uses around a salt well that one wonders what would happen if it were suddenly cut off. The geomancer uses bamboo tickets to decide the location of a new well; the mechanic, a bamboo rule to measure the land; the

*Joining bamboo pipes in
Szechuan, 1637.*



priest, bamboo joss sticks for the opening rites. Bamboo ropes haul up the logs for the derrick frame, splice them together, and are tightened by bamboo wedges. Bamboo binds the drum over which the bamboo cable runs into the well, carried by a wheel edged with bamboo. The band first put into the well to carry the drill is of bamboo, as is the cable later used to carry the bamboo brine pipe, fastened to the bamboo cable by hemp. The brake used on the windlass that winds the cable is of split bamboo, and it runs on strips of bamboo lashed by bamboo rope to the wooden windlass. The water buffalo is harnessed with bamboo to the windlass to draw the cable out of the well, while the driver 'persuades' the awkward beast with a bamboo whip. The rope with which he is tied by the nose is of smaller bamboo, his stable divided into stalls made of old bamboo cable, and the sides of the buffalo barn made of old bamboo rope twisted about the upright posts. The well coolie wends his way home by the light of a taper made from an old bamboo cable.

finely and wrapped around the pipes to prevent their splitting in the hot sun. Bamboo hoops support the great brine vats which hold the brine before running into the boiling pans, through split bamboo supported by old bamboo cables.

"Bamboo matting separates the boiling rooms; attendants sleep on bamboo baskets which later carry the finished product, or enjoy bamboo sprouts while they watch the pans (often boiled with bamboo firewood) and scoop the refuse off the top with woven bamboo skimmers. The coolie carries his load of salt to market with a bamboo carrying pole, and his tally is recorded with a bamboo stick. His sun hat is made of bamboo, finely woven, to keep out the rain, while the mat on which the peddler spreads his wares is of bamboo. When it is impossible to use the bamboo further in the industry, it is given to the labourers who sell it, repair their homes, or boil their rice with it. The expert boiler, watching the pans, blissfully smokes a bamboo water pipe, while his wife sews shoes with soles of bamboo leaves, by light of a vegetable oil bamboo lamp. He dips the brine from pan to pan

"The brine runs to the boiling pans through bamboo pipes, supported by bamboo pieces split

*Brine conduits in bamboo
piping at the Tsu-liu-ching
salt fields, Szechuan, 1944.*



with a bamboo dipper and strains it through a bamboo sieve. Bamboo guy ropes hold the derrick secure when the great gales blow, and the wheel at the dizzy height of the mighty derrick is trussed with bamboo. . . . The subject is not exhausted, as there are many other uses to which bamboo is put daily, but the reader will readily see that, if bamboo were taken from the market here in Tzeliutsing, it would paralyze the salt industry."¹⁵¹

SANDALS. "In Southern China the sheaths of a large thorny species (*Bambusa sinospinosa*) are torn into narrow strips to serve as the weft of coarse sandals."¹⁵² The usefulness of these sandals on slippery heights is remarked by a Chinese woman, a botanist at Harvard's Arnold Arboretum, recalling mountain treks in western China in her youth, "Climbing the Trails of the Giant Panda." Somewhat like those monsters of myth with hide so tough that it could only be cut by their own claws, the panda is sought shod in sandals made from the culm sheaths of its favorite food—bamboo. Perhaps the rarest animal in captivity, the most expensive according to the *Guinness Book of Records*, it lives in an ancient land mass that predates the Himalayan uplift in the early Tertiary period. Called the "white bear" by the Chinese who have known it some four thousand years, the panda is actually a cousin to raccoons, first heard of in the West in the nineteenth century and first seen in the Chicago zoo in 1937.

In the early 1940s, the British were offering fellowships for study in England to anyone who could catch one. "When a giant panda is ready for shipment to England, a fellow in any branch of the biological sciences may be chosen to accompany the animal for a year's research in British institutions."¹⁵³ Miss Hu, anxious to study at the Royal Botanical Garden at Kew, set out to capture a panda from the bamboo forests in northern Szechuan: "At Ya-chow we hired thirty-one porters to transport our supplies and equipment. One of the most important items among our supplies was two hundred pairs of sandals made of bamboo fibers. In a country where leather shoes are rare and climbing boots are unheard of, these bamboo sandals are indispensable for high-level climbing. They are relatively inexpensive and comparatively strong, and they do not shrink when wet. Most important, the rough ends of the tough fibres extending from the outside of the soles hold the steps in slippery places. In the mountainous region of west China, even the recognized highways between county seats are steep and

Pandas, whose lives are lashed more firmly to bamboo than any other animal, are presently threatened in their native mountains by

the flowering and death of bamboo species in their area. A modern papercut of a panda with its totem plant, from Fushun, China.



narrow trails, and the byways are still narrower, often only steps cut on the hard rocks of steep mountainsides, with roaring torrents a few hundred feet below. A slip may mean death. The trails in the land of the giant panda are only occasionally climbed, by hunters or medicine diggers. The morning mist, the frequent rains, and the melting snow render these paths wet and slippery all the time. The bamboo sandals are the conventional footwear for climbing trails in this region."¹⁵⁴

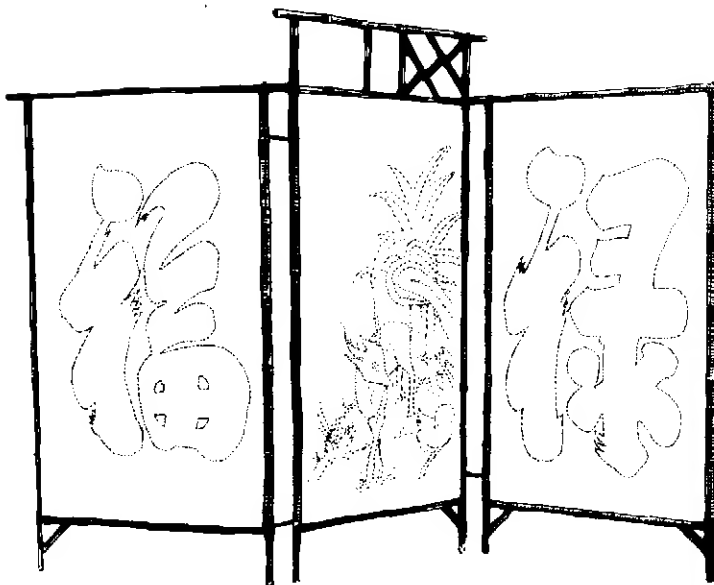
From Miss Hu's further descriptions of the grandeur of the terrain, it sounds so much more inviting than a British zoo that I am happy to report that her two hundred sandals permitted her and companions to climb the trails of the giant panda . . . without ever so much as glimpsing the beast. "With the demand of many zoos throughout the world and the favorable foreign exchange, the capture of a specimen means a fortune to each of the cooperating hunters. Yet year after year experienced hunters have gone hunting in vain. Likewise, in my expeditions, I have not seen any giant pandas."¹⁵⁵

SCAFFOLDING FOR SKYSCRAPERS. "A typhoon once struck two tall Hong Kong buildings, both protected by scaffolding: one of bamboo, the other of steel. The bamboo held firm, but the steel collapsed in a contorted heap. . . . You can sit by a twenty-story office window and watch the Bamboo Men operate. Suddenly you will catch a glimpse of a waving pole. Then a little man will appear, scampering up to the top. After tying more poles, he will disappear skywards. These are the men who have recently built a 4,000-seat theater in just over a week . . . They are the aristocrats of the local labor force and can command over \$500 a month. In a typical

operation—like repainting the exterior of an office building—trucks move in first to dump their loads of weather-beaten bamboo poles on the sidewalk. . . . The workers pick through the poles carefully, rejecting an occasional piece because it is cracked or weak—or simply because they don't fancy it. Next the heavy base poles are swung up and lashed to the window ledges or other projections. Soon the framework is towering over the street, and the workers are swinging along it, secured only by the tough bamboo strips and their own confidence."¹⁵⁶

And for supertankers: "Sixty thousand tons of freighter, a beamy heavyweight of the high seas, takes shape inside bamboo scaffolding at Aioi. Workers put the bulk-cargo carrier together by joining prefabricated interlocking units. Devising such techniques to produce ships far more quickly and cheaply than European or American yards, Japanese builders now launch almost half the world's new vessels—and the biggest, including the largest ship afloat, the fifth-of-a-mile long, 209,000-ton supertanker *Idemitsu Maru*. Japanese designers now plan leviathans of more than twice that tonnage."¹⁵⁷

SCALES. A passion for cricket fights dates in China at least from the T'ang dynasty (A.D. 618–906).



*Screen, Fu-chou, Fukien
Province, China, 19th century.*

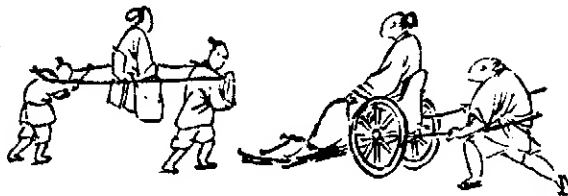
Many volumes, more weighty by far than their subject, devote themselves to the best diet and training. In the Sung dynasty, the Sun of Heaven himself neglected his vast empire, lost in this pygmy passion, bent above a 4-by-8-inch Kingdom of Crickets, the minicolosseum where the mortal combats were staged. The combatants entered by sliding doors at opposite ends of the bamboo arena. A screen separating them was lifted, and the battle of the bugs began, ending only with the death of one and the triumphal return of the other to his jade residence for a victory banquet of fresh shrimp. The most interesting element—for our purposes—in this cruel absurdity is the set of scales used to weigh the crickets, like prize fighters, before the match. The accuracy required for so delicate a task can be appreciated. The material chosen was bamboo. Then in World War II, when radio parts became scarce in China, they simply made them from bamboo, drawing on a sophisticated technology sharpened for centuries on such tiny triumphs as cricket scales.^{157a}

SCARECROWS. Those of bamboo are made in various countries in a variety of ways. "One often sees, in the more tropical parts of the Orient, scarecrows made from large stiff culm sheaths. The sheaths are either suspended by a short cord from the tip of a bamboo pole thrust into the ground at an oblique angle, or simply impaled upon a short stick set upright. As the sheath swings about in the breeze, the pale, polished, inner surface and the dull outer one reflect the light differentially, exaggerating the effect of its motion."¹⁵⁸

"If we have in Europe ugly scarecrows and such like for driving away the flocks of predatory birds from the young sowings and cornfields, so has the Malay also his own invention for the same purpose: long bamboo halms, at the end of which is fixed a bamboo wind wheel, moved by the slightest breeze with an ugly rattling noise which scares away the numerous rice thieves, finches and small parrots that swarm on the ripe fields. This noise, very disagreeable to the ear, continuously interrupts the stillness of tropical nature. The Javanese often places in various parts of his field many bamboo sticks, from which are suspended pieces of cloth and other light articles, and connects all these sticks with a bamboo or rattan string. The man who keeps the ends of these strings in his hand pulls them from time to time, concealed like a spider in a little bamboo house erected for this purpose on high posts."¹⁵⁹

Sedan chairs have been constructed since ancient times in China of lightweight bamboo frames and carrying poles, and used to carry persons of rank or riches. The common people

used them only to carry a bride from the house of her parents to her groom. In funeral processions, an empty chair was carried ritually to even the poor man's grave.



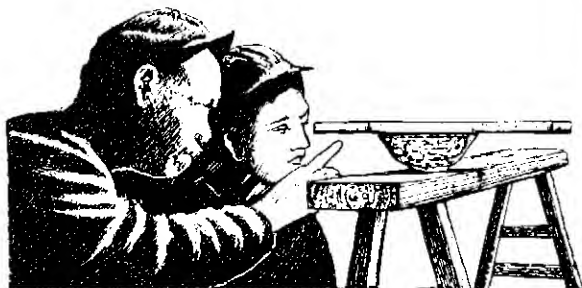
SEDAN CHAIRS. These have been constructed since ancient times in China of lightweight bamboo frames and carrying poles. Employed to carry persons of rank or riches, the common people used them only to carry a bride, concealed from view, from the house of her parents to her groom. As if to acknowledge all are equal on the other shore, in funeral processions an empty chair was carried ritually even to the poor man's grave.

SHIP DESIGN. Oriental ship design holds in the hull a ghost of the grove: "It is clear that the ships of East Asia cannot be genetically explained on the theory of the simple floating hollow log. Bamboo is their ancestral material, not wood . . . the Chinese hull is an elongated structure as full of transverse bulkheads as the stem of the bamboo is of those partitions which botanists call septa [nodes] . . . this construction sets the Chinese ship apart from the ships of the rest of the world."¹⁶⁰ (See also *rafts* and *fishing*.)

SILK. "Bamboo played an important though inconspicuous part in the history of European industry. When Justinian reigned at Constantinople (A.D.

A floating-sights water-level proto-theodolite used in 1957 for surveying irrigation projects. The bamboo with septa (nodes) bored

as sights floats on the convex meniscus of water in a rice bowl. This method is probably very old as well as very practical.



527-565), the court reserved a monopoly of the silk trade and its manufacture, the looms being worked by women in the Imperial Palace. Until then, the silkworms that feed on the leaves of the white mulberry were confined to China; those which haunt the pine, the oak, and the ash were common in the forests both of Asia and Europe, but as their education is more difficult and their produce more uncertain, they were generally neglected, except in the little island of Ceos, near the coast of Attica. The Persians had the monopoly of the trade in Chinese silk. This was a matter of deep concern to Justinian, who endeavored to procure the raw material for his looms through his adventurous Christian allies, the Abyssinians, who at that time were a naval and commercial power. His negotiations failed, the Abyssinians declining a competition with the Persians, whose proximity to India must give them an overwhelming advantage. Another expedient, however, presented itself. Two Persian monks, who had long been resident in China, traveled to Constantinople, a giant's journey, and proposed to the emperor that they should endeavor to introduce the eggs of the silkworm into Europe. The offer was accepted and liberally encouraged by Justinian. The two monks returned to China, and by smuggling the eggs in the hollow of a cane contrived to elude the vigilance of the Chinese, and made their way safely to Constantinople with their precious treasure. It is not too much to say that in that fragment of bamboo were carried the future commercial fortunes of Lyons, of Genoa, of Spitalfields, and all the other great manufactories of Europe, for from those eggs were descended all the races and varieties which stocked the Western World. But the pity of it is that we have not the record of the travels and adventures of those two Persian monks! This memorable importation is assigned to the year A.D. 552."¹⁶¹

SPLINTS. An Austrian doctor working several years in eastern Nicaragua noted the appropriateness of bamboo for splints to set broken bones in village settings where you often have to make do without the manufactured variety available in hospitals. Medical uses of bamboo are many, from tongue depressors to equipment for the handicapped. (See *crutches*.)

SUGAR. "For the first time in history, the *Dendrocalamus strictus* bamboo forests of Chanda, in the Central Provinces [India] began last March [1900] to exude a sweet and gummy substance in some abundance which was found very palatable

to the natives in the neighborhood, who have been consuming it as food. The occurrence of the manna at this season is all the more remarkable since the greatest famine India has known is this year visiting the country, and the districts where the scarcity is most keenly felt are in the Central Provinces. . . . The manna occurs in short, stalactiform rods, about an inch long, white or light brown in color, more or less cylindrical in shape, but flattened on one side where the tear had adhered to the stem. It was pleasantly sweet, without the peculiar mawkish taste of Sicilian manna, soluble in less than its own weight of water; the solution in repose deposited white, transparent crystals of sugar. Analysis showed 2.66 percent moisture, .96 percent ash, .75 glucose, a small quantity of nitrogenous matter, and the remainder consisting of a sugar which from its solubility, melting point, and crystalline nature appeared to be related to if not identical with cane sugar. The bamboo and sugar canes belong to the same order of grasses, and perhaps it is not unnatural to expect them to yield a similar sweet substance which can be used as food; but it is a coincidence that the culms of the bamboo, hitherto regarded as dry and barren, should in a time of great scarcity afford sustenance for a famine-stricken people.

"None of the natives questioned recalled seeing the substance before. They believed it to be 'bamboo manna.' The material is soluble in water, but insoluble in alcohol, ether, and chloroform. Crystals of sugar remain on evaporation which melt at about 166° C, and a little above this temperature assume a brown color and consistency of barley sugar."¹⁶²

SWIMMING POOLS. The owner of a construction firm living across the road from the USDA groves 9 miles south of Savannah, Georgia, told us that Thomas Edison had used bamboo to reinforce a swimming pool at his home in Florida. According to this professional, the pool was in good condition around 1980 and was then roughly eighty years old. (See *water storage*.) Edison had already demonstrated the more delicate capacities of bamboo's durability as the incandescent element in light bulbs (q.v.).

T Tabasheer,	tortures,
tables,	towers (for water,
tallies,	windmills or
teahouses,	rope-making),
tea strainers,	toys,
tea whisks,	trailers,
tents and other	transport,
temporary	traps for ambush or
structures,	fish or rats or tigers,

textiles,	trays,
thatch,	tree guards,
theatrical uses,	tree houses,
theodolite,	trellises,
thole pins,	trestles,
threshing boards and	triumphal arches,
machines,	trolley poles (England),
tiles (roof and floor),	troughs for feeding
tinder,	and watering
tipis,	chickens and other
tokens,	animals,
tongue depressors and	trumpets,
cotton applicators in	tubs,
hospitals,	tug and tracking
toothpicks,	cables,
torches,	twine.

TABASHEER. (tabaschir, tabashir): Used as variously as it is spelled, "famous for any and all ailments" (Porterfield), good for coughs, asthma, a renowned love potion, an antidote to poisons of all descriptions, it has long been in the Orient a medicine of almost mythical powers. "It is employed in western India to cure paralytic complaints and as a stimulant and aphrodisiac. . . . It plays a great role in Chinese medicine, and large quantities are exported especially from India to that country and Arabia. Tabasheer is also used in polishing, a quality it owes to its silicious composition."¹⁶³

Silica is apparently responsible also for its reputation as an effective antidote: "nowadays an artificial form is used internally to neutralize toxic agents by absorption."¹⁶⁴ *Melocanna baccifera* and *Bambusa arundinacea* are cited by Porterfield and Kurz as species especially abundant in deposits of tabasheer, but it is found in many other bamboos as well, in chunks up to an inch thick.

Jones (1966) and associates at the University of Melbourne in Victoria, Australia, studied the composition of tabasheer through an electron microscope. An abridged version of their findings: Bamboo absorbs large quantities of dissolved silica, and solid silica is deposited in its cell walls. This silica has been identified as opal by optical and x-ray techniques, and particles known as opal phytoliths of the same dimensions as cells can be isolated from the plant tissues. Large masses of silica found in the hollow stems of bamboo are called tabasheer. Known anciently but only recently examined by modern techniques, it is a porous, hydrous silica composed of roughly spherical particles about 100 angstroms in diameter, linked together in chains. As determined by the immersion method in sodium light, tabasheer has an index of refraction of 1.427

+/- 0.002; its specific gravity is 1.93, appreciably less than that of common opal, which tabasheer resembles in other ways: it is milky in appearance, translucent, and shows conchoidal fracture. Roughly parallel bands of different optical densities can be seen within the tabasheer in transmitted light. The chemical composition of tabasheer by weight is: SiO_2 , 85.82 percent; H_2O (-100°C), 5.87 percent; Na_2O , 0.002 percent; K_2O , 0.039 percent; CaO , 0.007 percent; and MgO , 0.004 percent. Tabasheer contains more water than is commonly found in opals but smaller amounts of alkalis and alkaline earths. Comparison of tabasheer with opal phytoliths, silica gel, and opal of inorganic origin under the electron microscope revealed basic but subtle differences that the interested reader can pursue in "An Opal of Plant Origin," *Science* vol. 151, no. 3709:464-6.¹⁶⁵

TEMPORARY SHELTERS. "If temporary shelter is required by the native or traveler in the jungles, nothing is so convenient as the bamboo; and how quick do they finish such a temporary house! A few hours' patience and the traveler is comfortably housed for the night, having not only shelter above him, but also his table, chair, and 'bali-bali'—bedstead—all made of bamboo."¹⁶⁶ These remarks suggest reflecting on bamboo for refugee camps in the wake of war, quake, flood, or whatever man-made or natural disaster, when instant shelter is required.

THEATRICAL USES. Bamboo's use is related to its convenience for temporary structures. Easy to carry, easy to assemble and disassemble, it is much used by traveling performers throughout the world in many ways that deserve study by schools. A report from China: "Itinerant theatrical troupes employ bamboo structures of a distinctive architecture, tall and narrow, with the walls often covered with gaudily decorated mats, and surmounted by ornamental devices of traditional rococo design. The floor, which is elevated several feet above the ground, is made of thin wooden planks laid on bamboo beams and held in place by thin strips of bamboo bound down by bamboo thongs. The top-heavy structure is held erect by means of long bamboo braces, to which is often added the security of bamboo guy ropes."¹⁶⁷ (*Fiesta assistant*, above, explores similar uses; see also *transport*, below.)

TRANSPORT. Rafts, ox carts, sedan chairs, carrying poles, wheelbarrows, tug cables, punting poles,

sails, docks, and even bikes have been made of bamboo. Its lightweight strength has anciently associated bamboo with travel and transport, as vehicle or accessory, axle or anchor, caulking material or bilge pump . . . a complete list would begin to repeat other entries. The next time you walk hilly terrain, carry a bamboo staff. Bridges of bamboo we have seen earlier. In some mountainous areas, bamboo stairs are also constructed at critical points of the path: "When the path goes over very steep and slippery ground, the bamboo is used to form steps. Pieces are cut, about a yard long, bamboo pegs are driven through holes made at each end, and a ladder or staircase is quickly made."¹⁶⁸

TRESTLE. "A trestle of bamboo, 125 feet high with a span of 400 feet, was erected near Miyaroshita, Japan, and used until a steel railroad bridge could be completed."¹⁶⁹



U

UMBRELLAS. "The most common umbrella, found in all parts of China, has a bamboo handle, spring, and ribs, and is covered with oiled paper," which may also be made of bamboo.¹⁷⁰

V

VALIHA. The valiha is the national instrument of Madagascar, an island with roughly one-fiftieth (2 percent) the land mass of its neighbor Africa but nearly three times as many genera of bamboo. (*Decaryochloa*, *Perrierbambus*, *Cephalostachyum*, *Hitchcockella*, *Hickelia*, *Nastus*, *Pseudocoix*, and *Schizostachyum* in Madagascar; *Oreobambus*, *Oxytenanthera*, and *Arundinaria* in Africa.)¹⁷¹ With this richness of bamboo to choose from, it is not surprising that the valiha, a bamboo



zither of sorts, should be central to the island's musical traditions. A record is available that includes photographs and detailed descriptions of the valiha and its musical history.¹⁷²

VIOLIN. "There is also a kind of Chinese violin called the *hyi ieng*. . . . It consists of a 2-inch thick bamboo joint, 3 to 4 inches long, closed at its extremity by a tightly stretched snake's skin. To this is inserted a bamboo handle about 2 feet long, to the upper end of which are fixed the two strings resting on a bridge on the snake's skin. A piece of split bamboo is used as a bow."¹⁷³

It is actually a mistake to try to understand or judge these instruments in relation to Western counterparts. Calling them "a kind of violin" or "zither of sorts" is a convenient shorthand, but it does more to confuse their reality than to clarify it. Best to scrub your ears of all memories of Mozart and try just to hear how they sound. (See *Bamboo Discography* for a brief listing of records, p. 333, and the Hornbostel-Sachs system of instrument classification, p. 74.)

Whip.



<p>W Wagons, walking sticks, walls, war, water jugs, water pistols, water storage, waterwheels, waxes, weapons, weaving shuttles and looms,</p>	<p>weirs, well sweeps, wheelbarrow, whetstones, whips, whistles, wicks, windbreaks, windmills, wine storage, winnowing machines, writing brushes.</p>
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WAR. The art of war has many ancient links with bamboo. "Fine spears and arrows as well as bows and shields used to be made of bamboo: so are torches, conical military hats, criminal beaters, and splints for binding up wounded limbs."¹⁷⁴

Research on bamboo often increases in wartime, the forceps of history which drag new technologies into the world. Scarcities in World War I inspired the Chinese to build railroad trestles of bamboo cement. In Vietnam, U.S. military interest in bamboo rose, as it had also in World War II, when the U.S. government funded investigations into bamboo ski poles to replace the supply of

Arundinaria amabilis cut off from China. Fighting in the Alps, you discover the best ski pole shafts are built of this species, growing only in a very narrow range of southern China. So you go investigating, quickly, the properties of bamboos of abundant known supply in territories ally to your purposes. McClure (1944) did that, from the United States to Brazil.

Bamboo cement receives a spurt of interest in modern wars because you need to build landing strips and other installations in the middle of the jungle where you find no iron and much bamboo. Soldier shelters, from semipermanent barracks to armatures for field tents, are rapidly constructed from bamboo when the material and labor skilled in its use are available. Revetments of bamboo and earth can protect from heavy bombardment.

Bamboo ambush is a genre in the art of war in Southeast Asia: "The so-called 'rangyoos' are thin bamboo pegs sharpened at both ends which are put in oil and slightly burnt in fire. Such pegs are put vertically in the ground hid in grass. They cause very dangerous wounds and, in wet weather, can penetrate also the moistened soles of shoes. In the campaign of the Dutch against the Booginese of Boni [Celebes] in 1859, the Dutch soldiers all carried bundles of such rangyoos, but the Booginese were not such fools as to run into them, nor had the Booginese rangyoos any effect upon the Dutch troops. All the Malayan tribes, and the hill-peoples of Assam and Burma use similar pegs, and larger ones are employed against cavalry, placed singly and obliquely in the ground in high grass, or cross-wise and tied. It is a very common custom with Malays and Burmans to place strong bamboo poles across paths in long grass or dense jungle, fixing them firmly at the one end while the bamboo is tightly strained and fastened at the other end in such a way that it immediately unbuckles as one steps on it or only uncautiously touches the pole, thus striking with all force against the legs of the passersby or the passing enemy. The people of Arracan and Tenasserim have, for catching tigers, a similar method. The bamboo pole is then vertically planted in the ground and strained downwards by means of a strong rope terminating in a large noose arranged so that the tiger, which preys upon a bait laid for him, must pass and touch the noose, when, of course, he is at once launched into eternity."¹⁷⁵

WATER STORAGE. Bamboo-cement tanks have been used as an alternative to dirty, distant, and

insufficient water stored in small earthenware jars or costly aluminum tanks. The Adaptive Technology Group (ATG) in rural Thailand, with help from the civil engineering department of Chula University, evolved feasible designs for bamboo-cement rainwater storage tanks that proved to be four times cheaper than galvanized steel tanks of equivalent size. Easy to build using local materials and local technology, independent of outside supplies or assistance, the tanks are an exercise in self-reliance, a demonstration that the rural villagers can autore-solve their most critical problems. Five-day seminars were conducted in three villages in October 1980, and a handbook was distributed in additional areas. For drinking and cooking water, figuring daily personal consumption at roughly 5 liters, 3,000 liters or 3 cubic meters is needed for a family of five during the four-month dry season.

Construction begins by leveling and compacting the soil base. Bamboo is then woven into a square structure, with spacings of 2 square inches between strips, 20 cm wider than the diameter of tank base on both sides. Walls are next woven and tied to the base. Flint coat is painted on the bamboo before coating with a mix of cement to sand to gravel (1:2:4) 10 cm thick in the base, 3 cm in the walls, where two coaters work opposite one another, wearing thick rubber gloves. Coating hardens one day before giving a finish coat. A bamboo lid is woven, leaving a hole where rainwater can be channeled to enter and which is large enough for people to get in and clean. The tank is cured a week or two covered with straw and dampened as needed with water.

Communication of the technique: Lakdan is a village 300 km from Bangkok in northeast Thailand where 120 households suffering many years from water shortage have to fetch water from a source 2 km away since the town pond is often dry. In July the abbot of the local temple invited ATG to send a study team to investigate village conditions. Two workers visited in August and proposed an official letter from the village headman and the abbot to the Thai government requesting a large pond be dug at the low end of the village for general village use. For individual families, bamboo-cement tanks were proposed, and four workers returned two months later for five-day demonstrations at Lakdan and another village of 150 households 40 km away. Twelve young men and women were chosen by the village to participate in the construction and learn the technique to later extend to others. A four-day training was also given to thirty monks and twenty

"local elites" from a large number of villages suffering from water shortage.

Training included theory, practice, and group discussions. General water problems and the technique and importance of passing on the training were stressed. The fifty participants, in groups of ten trainees per trainer, built a tank per group, 1.5 m in diameter by 1.5 m high. Five new useful water tanks for the school where the seminar was held and fifty enthusiastic and knowledgeable messengers of the bamboo-cement method came out of the seminar—which was also a demonstration to all involved of participatory solutions to community problems.

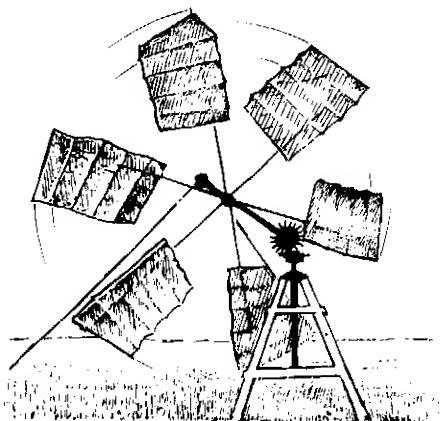
Discussions were held about applying the format to other rural difficulties. The participants were respected members of their respective communities, so their strongly positive endorsement of bamboo-cement technology would be well received. It was felt that successful training in an alternative technology solution to water storage would make the villagers more self-reliant and receptive in other areas of innovation as well. A Bangkok bank donated a sufficient quantity of money so that a bamboo water storage tank could be built in the village of each participant and help spread the message. ATG will send workers to these villages as consultants to check on progress and resolve any problems confronted in construction.¹⁷⁶

Hidalgo (1978: 88–100) illustrates with thirty-eight photos the process of making bamboo-cement tanks for water storage and processing coffee and for panels that admit of various uses.

WATERWHEELS. "These and the cups with which water is raised to the rice fields are made of bamboo . . . A split bamboo pole with the partitions knocked out serves to conduct the overflow from higher rice paddies across a country path to another on the other side on the next lower level. Also, they are ingeniously fixed so as to catch water from the edges of the sluice that feeds the waterwheel of a primitive flour mill and carry it to the axle supports for the purpose of reducing the friction. As long as the water comes through the sluice, the axle of the wheel is automatically lubricated."¹⁷⁷

WAXES. "While conducting experiments on *Sasa paniculata*, Tsujimoto found that the leaves of this species, upon extraction with petroleum ether, yield approximately 1 percent of crude wax. When refined with animal charcoal in ethyl acetate, the product was a hard, brittle wax melting at 79–

Oblique axis windmill fitted with mat-and-batten sails for irrigation.



80°C and possessing, in general, the properties of carnauba wax."¹⁷⁸

WHISTLE KITE. "A kind of very curious whistle is used by the Chinese for driving away evil spirits. Several holes are pierced in a piece of bamboo, two of the natural knots being left, one of which offers an opening out in a slope; to each extremity are fastened two long strips of paper from 15 to 18 feet in length and 6 to 8 inches wide. A string is attached to a groove made in the bamboo, and when there is a little wind, this wierd whistling kite is sent aloft and a monotonous whistling is produced, resembling at times the noise of a jet of steam, sometimes the sighing of the wind in trees."¹⁷⁹ (See, also, *flying art*, above, and pp. 83–84, 252–254.)

WINDMILLS. "Numbers of six-sail wind machines are currently in use in the salt works around the northern shore of the Gulf of Thailand. The machines are of about 6 meters diameter and use bamboo spars, rope, and wire to form a wheel which carries six triangular sails, each woven from rush or split bamboo."¹⁸⁰

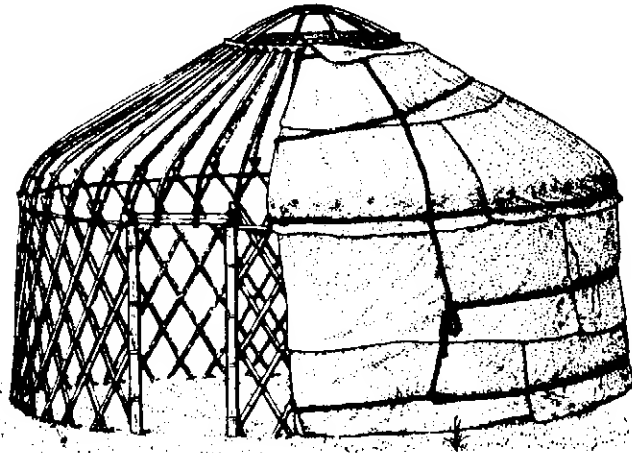
These wind machines drive paddles of traditional water-ladder low-lift pumps. Wind energy is receiving more attention worldwide in developing countries, where only 12 percent of the rural population has electricity, and where—according to FAO—centrally produced power from thermal or hydroelectric stations remains centrally consumed: 80 percent for urban industry, 10 percent for urban domestic consumption, and 10 percent trickling out to rural areas.¹⁸¹ By contrast, decentralized energy sources such as wind generators or wind-powered

irrigation pumps are directly controlled by local owners. Irrigation is the most crucial issue in increasing agricultural production, and wind machines have proven a low-cost way of lifting water with locally crafted equipment. "A small number of people are working on water-pumping windmill designs in developing countries. Most promising at present appear to be sail windmills—machines with cloth or bamboo sails rather than fixed blades."¹⁸² Bamboo in the wind was a traditional favorite of Chinese artists for depicting the vital force of nature. Modern appropriate technologists are rediscovering its ancient Asian role in towers and sails to harness that force for serving human needs as well.¹⁸³

WINE STORAGE. Wine kept in green bamboo a few days is said to improve in flavor. Bamboo has other associations with wine, as well. "The custom so common among the southwestern tribal peoples of drinking wine ceremonially through long bamboo



Washing fermented rice (for making wine) in bamboo baskets.



Yurt.

tubes is one which links them directly with the ancient peoples of the Fertile Crescent."¹⁸⁴ Satow remarks the Japanese practice of making bamboo sake (q.v.), and classical Chinese poets felt for centuries that a bamboo grove was the best of all possible places to get drunk.

X

XYLOPHONES. See page 00 and *musical instruments*, above.

Y

YURTS. Some made of bamboo are discussed in Kuehn's *Mongolian Cloud Houses* (1980:43). See also Charney's *Build a Yurt* (1974).

Z

ZITHERS. See p. 255 and *musical instruments*, above.

"This résumé of the uses of bamboo, although still meagre, may yet remove any surprise upon reading that the Radjahs of Boutan were proud in asserting that their forefathers sprung from the womb of a bamboo."¹⁸⁵

CHAPTER 2.

1. Porterfield 1933:181-3.

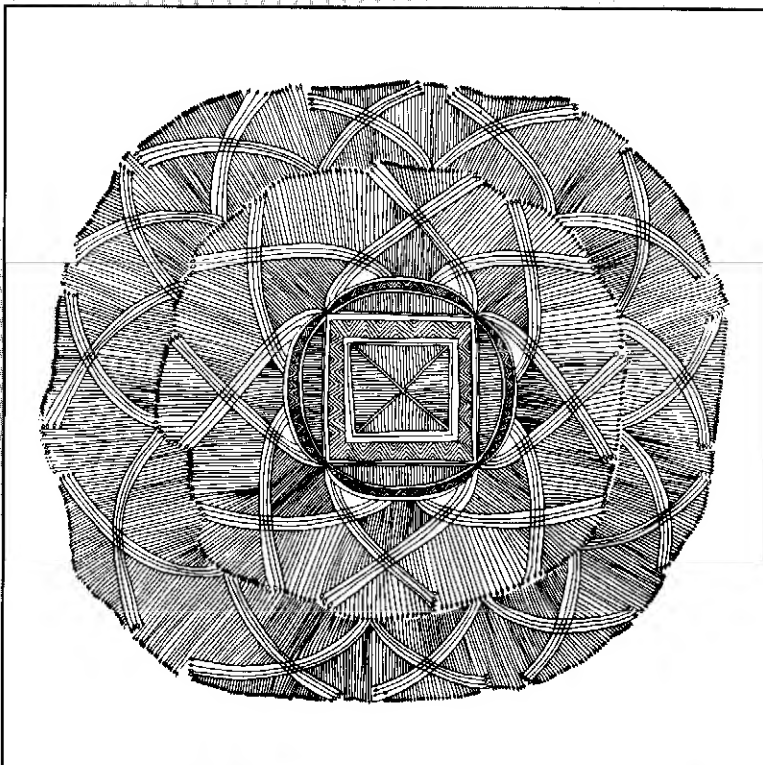
"During my war years in Chungking, a Chinese pointed out how history had failed to record one of man's great ages. 'Your books,' he said, 'speak of the Iron Age, Bronze Age and Steel Age. But in Asia we have the Bamboo Age.' And he demonstrated how bamboo was used in China's blockaded wartime capital: for water and sewer pipes, for tools and knives, to replace broken springs in automobiles and trucks, for building

materials and even for radio parts and watch springs." From an article "The Ominous Blooms of Japan's Beloved Bamboo" by Carl Mydans, undated and without a source in our Xerox from the Smithsonian.

2. Needham 1980:iv.2:129, 142.
3. Ibid.: 145.
4. Ibid.: 153.
5. Ibid.: 188.
6. Ibid.: 272.
7. Ibid.: 313.
8. Ibid.: 333.
9. Ibid.: 355.
10. Ibid.: fig. 695.
11. VITA 1963:86.
12. *Encyclopaedia Britannica*, 3:17-8 (1961).
13. Appropriate technology is sometimes called "alternative technology," an unfortunate name in some respects because it suggests "second rate"—what you do if you can't afford the real thing. In the United States, 1 to 2 million wood space heaters are sold yearly. In 1980, they contributed more energy than nuclear power. In this case, which is the "alternative" energy source?
14. Papanek 1971.
15. Paul Ehrlich, quoted in "Ecology, Capitalism, and Communism," *Co-Evolution Quarterly*, Spring 1977:46-8. A recommended article.
16. Needham 1980:iv. 2:63.
17. Hidalgo 1974:245-51; see Leon 1956, Hidalgo's source.
18. Kurz 1876:235.
19. Varmah 1980:12.
20. Young 1961:29.
21. Laufer 1925:3-4.
22. Porterfield 1927.
23. Kurz 1876:231.
24. Munro 1868:29.

25. Darrow 1981:691. Review of *Bicycling Science* by F. Whitt and D. Wilson (Cambridge, Mass.: MIT Press).
26. Needham 1980:iv.2:63.
27. Darrow 1981:680-3.
28. Ibid.: 190-1.
29. Simmonds 1963:334.
30. Freeman-Mitford 1899:273-4.
31. Mannix 1956; Schurmacher 1949.
32. Kurz 1876:225-6.
33. Needham 1980:iv.3, sec. 28 Bridges: 191.
34. Wilson 1913, l:171.
35. Kurz 1876:228.
36. McClure 1958c:402.
37. Kurz 1876:228.
38. Porterfield 1933:179.
39. Needham iv.2, sec. 27: 64.
40. Kurz 1876:229.
41. Porterfield 1927:40-1.
42. Kurz 1876:229-30.
43. Ibid.: 230.
44. Darrow 1981:581,566; see also 100-1 for cart designs.
45. Ramaswamy 1979. (Reviewed, Darrow 1981:566.) Free to Third World groups. See bibliography.
46. McClure 1958c:405.
47. Varmah 1980:12.
48. Kurz 1876:228.
49. Hutt 1979, Introduction.
50. Kurz 1876:236.
51. Junka 1972:19-20.
52. Horn 1943.
53. Dasmann 1980: *Planet Earth 1980*.
54. Darrow 1981:569.
55. McClure 1956c:39.
56. Ueda 1960.
57. Piatti 1947b.
58. McClure 1958c:401.
59. Darrow 1981:118.
60. McClure 1958c:406.
61. Ibid.
62. Ibid.: 397.
63. Darrow 1981:485.
64. Ibid: 484. Review of *Appropriate Technology for Grain Storage*, 94 pages, by the Community Development Trust Fund of Tanzania. \$2.50 from Economic Development Bureau, P.O. Box 1717, New Haven, CT 06507.
65. *Encyclopaedia Britannica* 3:17-8 (1961).
66. Freeman-Mitford 1899.
67. Aero 1980:100-1.
68. Austin 1970:130-5, 180. Seventeen photos document fan fabrication.
69. Porterfield 1927:38-9.
70. Sloane 1979:51-4.
71. Austin 1970:13.
72. Tsuboi 1913:221.
73. Ferrar-Delgado 1951.
74. McClure 1958c:401.
75. Kurz 1876:226-7.
76. Hidalgo 1974:244.
77. Dickason 1966:7.
78. Aero 1980:133.
79. Ibid.: 134.
80. Darrow 1981:494, quoting Dasmann's *Planet Earth 1980*.
81. Eckholm 1976:26.
82. Ibid.: 18-9.
83. Club du Sahel 1978:45.
84. Aprovecho 1981:6.
85. FAO 1978.
86. Darrow 1981:496.
87. Ibid.: 498. From Sanger 1977.
88. Aprovecho 1981:10.
89. See also *diesel fuel*, above.
90. McClure 1958c:403-4.
91. FAO 1976.
92. Darrow 1981:512-24.
93. Porterfield 1927:44-5.
94. Needham 1980:iv.2: 313.
95. Ibid.: 578.
96. Freeman-Mitford 1899:282.
97. Needham 1980:iv.3. sec. 28: 295,339.
98. Hunter 1977:39.
99. Porterfield 1927:8-9.
100. Hooker 1854, l:29.
101. A. H. Church, Food Grains of India, Suppl. 1901:6. See *sugar*, below, for another form of bamboo food.
102. Aprovecho [359 Polk Street, Eugene, OR 97402] (503)345-5981 offers designs for a removable "renter's greenhouse" that can be adapted to bamboo.
103. Dickason 1966:5.
104. VITA 1963:270.
105. Needham 1980:iv.3. 391, 395.
106. Worcester 1966.
107. Hidalgo 1974:195-204.
108. Newman 1974; Peterson 1969.
109. *Melocalamus compactiflorus* is also used. Dickason 1966:5.
110. U Pe Kin 1933:635-8.
111. Kurz 1876:233.
112. Ibid.: 224-5.
113. Porterfield 1927:41.
114. Junka 1972:26-7.
115. Cave 1955:A3.

116. Aero 1980:22.
117. Kiang 1973.
118. Nonesuch Steel Band record jacket.
119. Lessard 1980:201.
120. Ibid.: 201-4: "The Angklung and Other West Javanese Bamboo Musical Instruments," by Elizabeth Widjaja, Lembaga Biologi Nasional, LIPI, Bogor, Indonesia.
121. Lessard 1980:202-3.
122. May 1983 and Reck 1977.
123. Sineath 1953:55.
124. Austin 1970:184, 186, 187: photos of *netsuke* and *inro*.
125. Lutz 1975. Brush pot photos. A full page photo of an extraordinary brush pot depicting a bamboo grove complete with philosophers occurs in Austin 1970:177.
126. Kiang 1973.
127. VITA 1963:367-8.
128. Lessard 1980:53.
129. Varmah 1980:20.
130. See Narayanamurti and Bist 1948, 1963.
131. McClure 1956c:40.
132. Dickason 1966:6.
133. Kiang 1973:17.
134. Kurz 1876:240.
135. Needham 1980:iv.2.587.
136. Aero 1980:109. "The Five Punishments."
137. de Fonblanque 1863.
138. Porterfield 1927:52.
139. Ibid.: 48.
140. McClure 1958c:396.
141. Needham 1980:iv.3.394.
142. Junka 1972:27. See also Thoria 1947.
143. More in *Scientific American* (July 5, 1919), 121(6):6; Sineath 1953:55.
144. Porterfield 1927:50.
145. Dickason 1966:5.
146. Needham 1980:iv.3, sec.28 Civil Engineering: 134.
147. Tsuboi 1913:219.
148. Needham 1980:iv.3: 604.
149. Ibid.: 597.
150. Satow 1899.
151. Crawford 1926: 171-2, abridged.
152. McClure 1958c:409.
153. Hu 170.
154. Ibid.: 168.
155. Ibid.: 171.
156. Shelter 1973:75.
157. *National Geographic* (Sept. 1967), 132(3): 317.
- 157a. Aero 1980:60-1.
158. McClure 1958c:409.
159. Kurz 1876:230-1.
160. Needham 1980:iv.3, sec. 29 Shipping: 389.
161. Gibbon, *Decline and Fall of the Roman Empire*, Chap. X1; *Encyclopaedia Britannica*, "Silk"; Freeman-Mitford 1896:31-3.
162. Hooper 1900, abridged; Sineath 1953:17.
163. Kurz 1876:239.
164. Austin 1970:22.
165. See also "Catalyst for General Use," *Chemical Abstracts* (1947), 41:3592.
166. Kurz 1876:223.
167. McClure 1958c:401.
168. Kurz 1876:224.
169. Sineath 1953:56. See also *Scientific American* (Feb. 1917), 116(124):3, "Building a Railroad Bridge of Grass to Expedite the Construction of a Steel One."
170. Aero 1980:237.
171. Numata 1979:231.
172. OCORA, OCR 18, Valiha—Madagascar. An extensive introduction. See also the excellent *African Music, A People's Art*, Francis Bebey, 1975:48 (Lawrence Hill & Co., Westport, Connecticut).
173. Kurz 1876:234.
174. Porterfield 1927:51.
175. Kurz 1876:237.
176. Tankrush 1981. Is the author's name a pseudonym or weird coincidence?
177. Porterfield 1927:44-5.
178. Sineath 1953:17. See also *Chemical Abstracts* (1940), 34:2177.
179. Kurz 1876:234-5.
180. Heronemus 1974. (Reviewed in Darrow 1981:140.)
181. Darrow 1981:558.
182. Ibid.: 593.
183. See Chapter 3.
184. Austin 1970:22.
185. Kurz 1876:240.



3. THE MODEL TO THE EAST

*Just here body, just now mind,
just this act will leave behind
nothing in the shoreless sea
of nothing which envelops me.*

*Eye just see, just taste tongue,
ear just hear, just breathe lung—
just this moment you may find
just now body, just here mind.*

—Buddhist lullaby

THE ARTIST'S ALLY, THE EMPEROR'S ORNAMENT, THE PEOPLE'S FRIEND

Among painters in China, bamboo occupied as central a position as the human figure does in the West. It was the nude model for the East, providing artists with brush and paper as well as subject for their work. Manuals of countless masters contain a long tradition on the subtle nuances of depicting its moods and motions. It was a primary theme of poets as well, and centuries of moral philosophers regarded bamboo as a complete pattern for correct human behavior. It stood for constancy because it remains green throughout the year; fidelity for its patient resignation beneath the weight of winter snows; integrity because when split its parts are straight and even; purity because its heart is always empty and immaculate; rectitude since in the hurly-burly of the wildest storm, it bends without breaking, and stands up again.

Bamboo aripana. This symbolic mandala of the cosmos as a bamboo grove was painted by the village women of Mithila in NE India as image magic for a

fertile, healthy family, which grows up around an ancestor like a clump of bamboo around the first shoot.

Bamboo bone.

There are bamboos 10,000 meters high if you look at their shadows by moonlight.

—Su Tung-p'o

*Bamboo itself would we have writ
had we the hand to scribble it—
but only glimpses of the grove,
brief leaves of a branch we love
black the pages of this book.
And all the planet scriptures say,
"Words are wild and miss the Way."*

*Those who wander by and find,
wading in our shallow brook,
an inward wish to dive more deep
down the wisdom of bamboo,
pilgrims of the plant, must leap
unmeasured fathoms further to
that central stillness of the mind.*

*There the moon-dipped, winelit eye
of that sage crazy, Su Tung-p'o,
in China groves nine centuries ago,
drenched in imagination, saw
bamboo 10,000 meters high . . .*

*After unripe years of raw
and greedy study, we found how*



*the data addict will not know
bamboo, nor bookful botanists with loads
of learned lumber in their heads.
The busy expert will not see
the tremble of the living tree.*

*But a lover who believes
in hollow mind, much alone
with midnight and dawn's dew
jewels on the tips of leaves
mirroring a bamboo
morning, may hope to gnaw
the dark and empty bone
of it, and know the skin.*

Bamboo was referred to as "this gentleman" in literate Chinese. With the orchid, chrysanthemum, and plum, it was one of the Four Noble Plants of Chinese garden lore. And with the plum and the pine it was among the Three Friends, a plant trinity representing Lao Tzu, born beneath a plum tree, the Buddha, who died in a grove, and Confucius. The "mother culm" in a stand of bamboo, which feeds nutrients to her surrounding offspring, was regarded as an image of altruism in Chinese folklore. In northern India, aware of the cooperative underground union of a clump in which apparent individual stems are in fact interfostering fellows of a single plant, village women painted a stylized bamboo grove on their walls as a prayer for a happy family. Mythologies of a number of early cultures in both hemispheres regarded an empty bamboo culm as the womb of the race, and in China until recently the plant was often chosen as a spiritual parent or "godfather."

If parents are too poor to bring up their children, especially their sons, the child may be commended at the instigation of a fortune-teller

to the care of a tree. The spirit of the tree henceforth becomes its patron. Because it is regarded as a prince among trees, the bamboo is preferred before all others for this kind of adoption. On this account the child, because he has become the ward of such an influential spirit, may have a better chance in life.¹

The spirit of bamboo was called upon not only to secure the future, but also to discern it. The Kachins of the northern hills region in Burma place sections of the thin-walled *Pseudostachyum polymorphum* in a fire, and the "nat" or spirit priests divine the future by the pattern of explosions.²

The origin of bamboo itself has been the source of various myths. A Japanese creation myth recounts that the first grove grew where Izanagi, one of their creator gods, flung down his fine-toothed comb—and up leapt the erect Adams of bamboo.

The eminence of bamboo in Japanese culture is suggested by an honorific formerly bestowed on her emperors: "King of the Bamboo Garden" (*Take no Sono*). Many cultural forms are limited to an elite or loved only by the multitudes, but one characteristic of bamboo in oriental culture is its pervasive popularity among all social classes. The pampered favorite of the emperor's garden was also a standard component of popular art forms. In lantern paper cuts, for example, a folk art dating from the T'ang dynasty (A.D. 618–906), split bamboo provided the frame, pulp provided the paper, while the plant itself provided a motif for the traditional lantern, often graced by a full moon and a few culms in this "poor man's stained glass" glowing in the night.³ As for bamboo's place in oriental music, some musicologists consider bamboo instruments and the prominence of idiophones as the two chief acoustical features of that vast culture area stretching from Korea to Indonesia.*

Wherever bamboo abounds—if traditions have not been severely ruptured by conquest—it

*Editor's note: When Western students began examining planet music of other cultures, they found that the traditional Western division of instruments—strings, woodwinds, brass, and percussion—were often not applicable to the sound devices they encountered. Eric von Hornbostel (1877–1935) and Curt Sachs (1881–1959) suggested a more inclusive classification (the Hornbostel-Sachs system): sounds are produced in *idiophones* by the unstretched material of the instrument itself; in *aerophones* by a vibrating column of air, with a few exceptions such as a bullroarer; in *membranophones* by a skin or other membrane stretched over a resonating chamber; in *chordophones* by stretched strings; in *electrophones*, added in 1914, by electrical current. (May 1983:xii.)

Four out of eight immortals use bamboo

If you peer deep enough into the misty peaks of China's past, you'll find *Chang Kuo Lao*, a mountain hermit with a magical white mule that carried him long trips in all directions and shrank to pocket size when not needed. Chang Kuo Lao carried a bamboo drum—and drums in traditional Chinese military music meant “Forward!” Even the emperor tried to get him to stop bumming about and take a steady job in the court . . . Chang Kuo Lao pulled his mule out of his pocket and hasn't been seen since.

After he fell out of a peach tree one day and became immortal,⁴ the bamboo flute of *Han Hsiang Tzu* made flowers bloom, drew beasts from caves and birds from sky as he wandered the countryside playing. Vagabond patron of musicians, itinerant intimate of wind, riding mounted on the backs of clouds, his music was not for sale—and if some villager ever offered him money by mistake, he flung it about, laughing madly, and was off on his way with the weather down the next valley.

Chung Li-ch'uan one day in the country came across a young woman in deep mourning,

fanning a fresh grave. “My husband's last wish was that I wait to remarry till his grave was dry . . . I've found another man.” He helped her dry the grave, and she ran off so excited she forgot the fan, which *Chung Li-ch'uan* kept to remind himself of human memory. Later, he burnt his own house down to set off wandering, saving from the flames only his *Tao Te Ching* (“The Book of Road Power”) and the bamboo fan. According to some accounts, the fan later served to blow breath into corpses, reviving the dead.

One shoe off, one shoe on, *Lan Ts'ai-ho* in a long blue gown strolled the streets of a thousand towns, ragged, disheveled, and panhandling as she scattered blossoms from a bamboo basket of flowers, singing irresistible melodies about the crazy wisdom of letting it all go. It's ironic that this rootless gypsy became the lucky angel of gardeners and florists. She loves best a simple outdoor shrine, blessing any field where she finds her image propped up with devotion and a few flowers on a stone altar in the open wind.⁵



Chang Kuo-lao.



Chung-li Ch'uan.

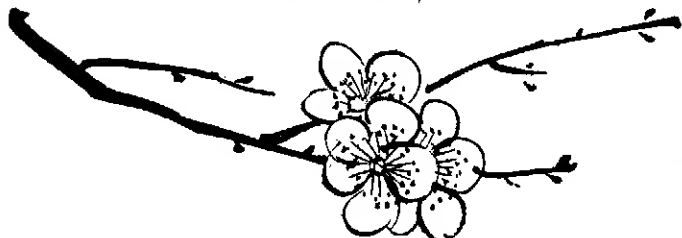


Han Hsiang-tzu.



Lan Ts'ai-ho.

has stood at the upright center of the most ancient tales and cultural values, reflecting its crucial position in the local economy. With prolonged and intimate acquaintance, bamboo has everywhere been used intensely, and intensely loved—with that mellow and abiding affection which made it not the Servant of Chinese folklore, but the Friend.



Plum blossoms, brave emblem of spring's recurrent victory over snows, provided a fresh challenge to centuries of brushes in China. "The plum trunk is a sinuous dragon with a feeling of iron power, curi-

ously twisted at cliff's edge; combed by wind, washed by rain; blossoms drawn tenderly in mists as though holding smiles and gentle laughter on the branch. The wonder of it can't be caught in words."

Flowers.

Flowers preach to us if we will hear.
—C. G. Rossetti

In her format of flowers, Lan Ts'ai-ho recalls many famous saints who selected the same message. Jesus suggested lilies of the field as the ultimate tailors, more radiant than Solomon in all his glory; and the Buddha, in his "flower sermon," held one mute blossom up in reply to acres of tedious questioning disciples. Flowers are a delicate element of the tea ceremony, where their ritual use formed the root of Japanese flower arrangement. The Japanese schools themselves are blooms on one branch among many world traditions. In the San Francisco Arboretum library, the art of displaying flowers is the subject of four yards of shelved volumes, which gives some notion of the degree of human fascination with a blooming plant. We give flowers to mark arrivals and departures, births and deaths, and all small versions of them in between. The sudden, theatrical opening of petals, which then soon strew the garden path, makes them a natural metaphor for motion. In the symbol systems of many traditions, flowers stand up on their stems for that fleet and frail/durable beauty of life in which only a wandering spirit who kisses the joy as it flies will live in eternity's sunrise, and be sure to die at home.

The zero zone.

Wandering, the world's longest art form, is also perhaps its most ancient, a subtle science old as

shoes. The nomadic nature of the immortals in Chinese folklore, their feet firmly planted on a cloud as you can see in their pictures, reflects their respect for the homeless. As though to acknowledge that wanderers and householders compose the world, the Wanderer and the Marrying Maiden are the only social roles dignified with a chapter in the *I Ching*. The wanderer is an archtypal nonrole in many literatures, enjoying a unique position by holding none. The Fool or Zero of the tarot pack is one famous example. "Full of intelligence and expectant dream, flute in one hand, in the other, a bamboo pole. Morning quiet . . . keen light . . . high mountains, sudden cliffs, vast masses of air . . . the spirit in search of experience! Only the sun behind you knows where you come from, where you are going, how you'll return by another road after many days."

Travel, like meditation, is a zero zone. It is institutionalized in the practice of pilgrimage, which forms a rite of all religions, like fasting, silence, solitude, or song, that handful of constants belonging to all spiritual seekers throughout the world.

Weightlessness—and a consequent ability to leap or fly long distances—is a mark of the Holy that hovers above many cultures as well. Up plus light equals Heaven. Down plus heavy equals Hell. Bamboo became the symbol of many immortals because its weightlessness was crucial for wanderers—which gods and heroes usually are. The bamboo staff and backpack-basket became the equipment of many a pilgrim or apprentice saint in the ancient East, where actual physical homelessness was regarded as the most effective metaphor to help us inhabit at last the true dwelling of our inward village, that abiding flux in which existence swims. "Leaving home" in Buddhism came to mean to adopt the Buddhist teaching, and in the Zen tradition, "travel for study" was the complementary pole to "sitting quietly doing nothing." The



Bamboo fool.

monks were called *unsui* or "cloud-water" to remind them of the easy motions of enlightened mind through which the nonopposing body also flows happily as water and floats effortless as clouds.

Image magic.

*Ponder 10,000 volumes,
wander 10,000 miles.
Stick like glue to the four treasures.
Drown the brush daily,
grind the inkstone to dust.
Take a week to paint a creek.
Spend a month on a rock.
Go through complexity
to simplicity.
Learn method
to get rid of it.*

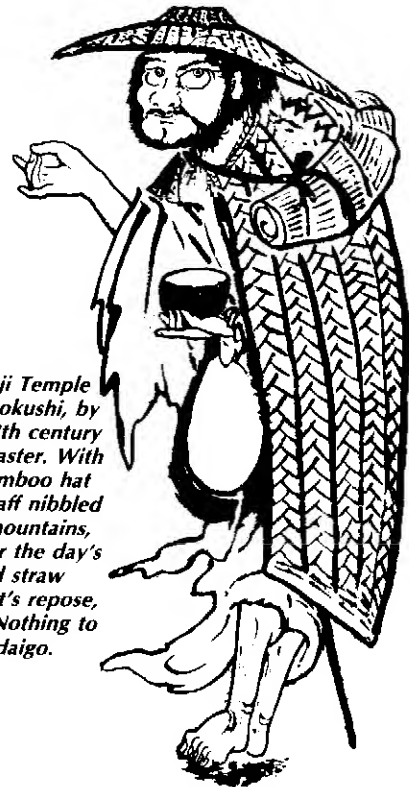
—Mai-mai Sze

The journey played an integral part in the training of oriental artists as well as holy men. In the earliest days, there was less of a distinction between the path of the spirit and the path of art. For the shaman-artists of the Orient, as for their cousins in the West, the journey was a central part of their learning and power—sometimes chosen, sometimes an exile in which they found themselves, by which they broke through to a realm of power denied to people safe in their village and home.

The magical power of painting has been felt from the earliest times in a number of cultures. The cave paintings of Europe were used to assemble power for the hunt, and in the East also the primitive shaman-artist regarded his brush not as an instrument to "hold a mirror up to nature" but as a tool to control it. Witness the farmer's son in the Japanese tale who constantly drew cats: he was fit for nothing but his obsession of perpetually sketching this one subject, so his father gave him away to the local temple. "You're useless for farming. Maybe you should be a priest." But the priests also became exasperated in time with his addiction to drawing and sent the boy away. Arriving one night at a haunted monastery where the monks had fled, routed by a local demon, he sketched an enormous cat in the crusted dirt of the abandoned temple wall before retiring for the night to a distant corner of the grounds. In the morning, he found in the temple an immense rat whose carcass stretched from the altar to the main door . . . and from the huge dusty mouth above him on the wall, the fresh blood dripped.

Modern artists can readily relate to the notion of art as therapy or exorcism to drive our demons

Pilgrim. Daitokuji Temple founder Daito Kokushi, by Hakuin, early 18th century Japanese Zen master. With rain-battered bamboo hat and overcoat, staff nibbled by a thousand mountains, begging bowl for the day's refreshment, and straw mat for the night's repose, Kokushi taught Nothing to the Emperor Godaigo.



out. They can also easily share the attitude if not the brush of that court artist in China who, powerless to resist the demands of the emperor, painted the ordered landscape on the palace walls. When the royal patron arrived to inspect the finished work, the painter leapt up into it, ascending a path that entered the wilderness in the left foreground, and disappeared into the dark mouth of a cave tucked in the mountains high above the astonished monarch, beyond the reach of applause or punishment. The work was then sucked, with increasing speed, off the wall and into the cave after him.

Somewhere between this earliest age of art, in which the artist magically transformed reality itself, and our late days when we have come to believe that the business of artists is the production of objects, lies that era when bamboo leaves rustled in the foreground of oriental art attitudes and when the primary function of art was not to provide artifacts for market but to effect a subtle alchemy in the artist's ultimate artifact, his own soul.



*Doors were made to open
roads were made to wind
ten thousand miles before you,
ten thousand more behind . . .*

Rocks and bamboo. Chao Meng-fu (1254-1322).



GALLOPING THROUGH RULES

*gem of the river
and evening—
windswept noble one
with small leaves—*

*in storm or calm
sunlight and rain
bending or upright
feel it from the heart,*

*galloping through rules
and beyond method
to the living quality
of bamboo itself⁶*

For a culture in which the transformation of the artist is the real issue, the work of art is merely the by-product and proof of that growth—the tracks, not the actual animal. “Build living Buddhas, not pagodas,” advises a Zen proverb reflecting the same attitude. From years of careful mastery of a rich tradition, a spontaneous rightness at last burst forth, vigorous, unhesitant, and ripe. “Wen T’ung, a sage born with knowledge, his bosom rich in hills and valleys, worked in harmony with Nature, kept within the rules—and yet roamed beyond the dusty world.” An artist attempting to reproduce nature without having first entered her was monstrous and ridiculous to the oriental. “To learn to paint, still your heart, clarify your understanding, let wisdom open in you like a flower.”

Ink’s excellent absence.

This wise passiveness in the artist is reflected in the oriental method of composition, in which a certain emptiness invites the viewer to join as a participant in the creation. Confucius remarks that a work is finished not when the last thing has been added, but when the last thing has been taken away. “Painters

nowadays,” complained Yun Shou-p’ing, “consider only brush and ink. The ancients considered its absence. If you can understand that *excellent absence of ink*, your brush is close to the tao of painting.”

Sweeping brushstrokes in which a fairly dry brush left the paper or silk still visible beneath were one expression of this appreciation of the excellence of emptiness, called “flying white.”⁷ A chance to explore absence on a larger scale was afforded by landscapes. “Mountain-water” paintings (*shan shui*), as the genre was early known in China, gave fullest scope to manifest the accord of heart and hand—soulwork and brushwork—whose harmony marked the fully mature artist. Often they were skyscapes, cloudsapes. “Clouds are the ornaments of sky, the embroidery of mountains and streams. They move as swift as horses, striking a mountain with such force you can hear the sound: such is the *ch’i* of clouds.”⁸ Snow, mists, or clouds often united or dominated the landscape, whose true subject was space: “Space, as it was rendered in the best of Chinese painting, might be described as a spiritual solid.”⁹

The roots of clouds.

It could be said as well that the true, invisible subject of Chinese painting was *ch’i*—the breath, vitality, or life force at the sightless center of the ten thousand things. The only way to paint it was to have it, and the ultimate proof of a painter’s work was the presence of *ch’i*, the lack of it the only failure. The Western genre of still life—“dead nature” in French (*nature morte*)—is the antithesis of the Chinese ideal. For the Chinese, even rocks, “the bones of mountains and the roots of clouds,” were bursting with vitality. “The Book of Rocks” in the seventeenth century *Mustard Seed Garden Manual of Painting* sums up instruction in rock painting with a single phrase: “Rocks must be alive. How could a cultivated person paint a lifeless rock?”

Though rocks were pulsing with the breath of Tao, other pieces of nature expressed *ch’i* more completely. The wind especially was “a tangible and direct manifestation of *ch’i*, described in the *I Ching* as a force of Heaven visibly stirring life.”¹⁰ And of all the subjects in the long history of Chinese painting, a traditional favorite for rendering the movement of wind and making visible its felt but unseen power was—bamboo.

Bamboo in the wind.

Stems bending in a heavy storm or with a light



Bamboo in the wind.

breeze running its hundred thin fingers through the leaning leaves, bamboo served as the ultimate test of an artist's power to assemble his spirit and fling it down on white paper with black ink in one rush of energy: "When calm, paint the iris; when angry, bamboo." The very names of brush strokes used to paint bamboo leaves indicate their nervous vitality: goldfish tail, startled rook, wild goose landing, swallows in flight, stag's horns, bird's claw, and fishbone are among those described in "The Book of Bamboo."¹¹ The bamboo and the plum tree were favorites of the scholar-painters. Bamboo was a perfect choice for these masters of the brush. A work depicting bamboos is both a painting and a piece of calligraphy. To produce such a work, it is absolutely necessary to have a steady wrist and complete control of brush and ink, and to work in swift, sure brushstrokes without the least hesitation. Experience teaches the values of ink tones, the way of handling a dry or wet brush, and a variety of brushstrokes. The bamboo plant, like the orchid, is interpreted as having all the ideal qualities of a scholar and gentleman, the essence of refinement and culture: gentle and graceful in fair weather, strong and resilient under adverse conditions. Supple, adaptable, upright, firm, vigorous, fresh. Even

the sweet melancholy from the rustle of its leaves has been translated into qualities of mind.

"Su Tung-p'o referred to bamboos as 'those dear princely joints.' His passionate admiration seems to have been shared by painters and connoisseurs to the point that amounted to a cult of the bamboo. Certainly, among all the subjects in its class, bamboo offers in painting the most direct and effective communication of the vitality called *sheng tung* (life-movement) and the breath (*ch'i*) of Tao" (Sze 1977:96-7).

The four treasures.

The Four Treasures in China—the brush, ink, ink-stone, and paper—were traditionally held in great respect. The brush and paper have long associations with bamboo, and centuries before bamboo paper, slips of bamboo were used as a message base. The brush was said to have been invented by one Meng Tien, a general under a Ch'in emperor who reigned from 221-209 B.C. Decorations on pottery from Shang-Yin dynasty (1776-1122 B.C.) were probably made with some kind of brush, however, so perhaps the general only improved it or was maybe among the first to use the more modern name form: *pi*, composed of *chu* (bamboo) and *yu* (brush or pen stylus), which first came into use at that time.

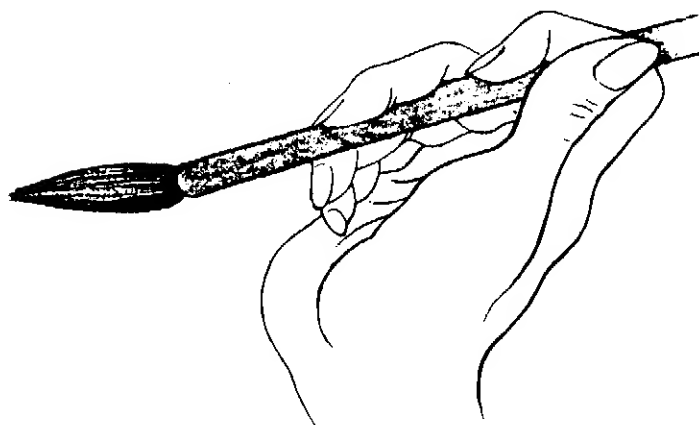
It is a direct representation of a hand wielding a brush in its bamboo holder to write or paint. Brush handles for ordinary use are made of bamboo, although in the past they were sometimes made of jade, quartz, gold, silver, or ivory, and tipped with buttons or knobs of these precious metals for special occasions. The plain bamboo handle has usually been the most satisfactory since its main advantage is lightness, an important factor in the balance of the brush.¹²

Hair of various animals—sheep, goat, deer, sable, wolf, fox, rabbit, weasel—have been used. Su Tung-p'o favored mouse whiskers. Chicken down, the hair of children, and bristles from a pig's neck are some infrequent alternatives. Goat, rabbit, and sheep are presently most commonly used. More rarely, plant fiber is used: sugar cane sucked dry was one Sung choice, and a T'ang critic spoke of a brush composed of mountain bamboo fiber that drew lines sharp as a slicing sword—an apt foreshadowing of the ideal in Japan centuries later, when samurai were judged by mastery of brush and sword, calligraphy and battle. Austin pictures a bamboo brush made by burying a piece of bamboo with the tip underground for several months.¹³

Bacteria eat the pith and leave the fiber to embody the artist's eye.

THE BRUSH DANCES, THE INK SINGS

Full appreciation of Chinese painting depends a great deal on the spectator's sensibility to the tempo of the brush, following it with eye and imagination as it dots, flicks, or moves forward, sweeping, turning, lifting, plunging, thinning out, swelling, sometimes stopping abruptly, sometimes crouching to leap again. It has often been remarked that the brush dances and the ink sings.¹⁴



Brush in hand, hand and heart in agreement.

Sumi-e: the color of the heart.

Sumi-e is a style of painting particularly close to the nervous *ch'i* of bamboo leaves, trembling in the stillest air. The painter fenced rapidly with his brush on the fragile paper which tore if he paused. Black was usually the only color—called “the color of the heart” because it could convey the feeling of all the rest. “The aim of the *sumi-e* artist is not the reproduction of the subject matter but the elimination of the inessential.”¹⁵ Not to record every rock on the mountain or each leaf in the grove, but to capture—with a spare economy of strokes—the moment-by-moment urgency of life itself. The paper is thin, the brush is wet—a pause will soak and rip the page—quickly! quickly!

Sumi-e is the art form that most closely approximates live music, whose just-now, once-only quality admits of no corrections: Flutes have no erasers. To achieve fluid motion, the brush is held lightly, perpendicular to the paper with the tip of the thumb and the index finger, at least 5 inches above the hair of the brush, with the elbow free. The posture of the

painter is important. Slumpy makes a sluggish line. He must paint with his whole body, hold himself as he holds his brush, erect, with the spine straight but not stiff.

“Ultimately, the brush becomes like a needle of a highly sensitive graph that records immediately the minutest impulse of the thought process.”¹⁶ You can't cheat. You can't lie. The simplest line measures the alertness of your mind and sincerity of your spirit. Look your heart in the eye, love your brush as you love your wife and happy family—and it becomes magic alive in your hand.

Su Tung-p'o.

Chinese painters were noted for their extravagant behavior. One, reproached by a friend for painting naked, replied, “The world is my home, my house, my trousers. What are you doing in my pants?” Among them all, none was more dazzling-various than Su Tung-p'o (A.D. 1036–1101), a many-skilled marvel of Sung dynasty China, embodiment of the oriental art ideal of the complete person who could shine in as many directions as the sun. He was hired by a handful of governments, was friend to a dozen remembered geniuses and shelter to unnumbered and forgotten poor. A city planner who inspired the largest bamboo water systems ever built (in Hangchow, A.D. 1089, and Canton, A.D. 1096), he also excelled as poet, painter, and creative drunk—a classical role in Chinese cultural history.

When he laughed, his head fell off his shoulders. When he sketched, heaven and earth fell off his arm. “Su Tung-p'o painted old trees contorted like dragons, while his wrinkled and sharp rocks were queerly tangled, like sorrows coiled up in his



Su Tung-p'o, "The Gay Genius."



*Bamboo by my gate to
doctor my mood . . .*

breast. 'When my dry bowels are refreshed with wine, the rapid strokes begin to flow, and from the flushed liver and lymph, bamboos and stones are born.' " Su Tung-p'o fathered children as well as art. He was a family man stitched more firmly to the world than the old hermit or young monk without wife and child to send him into the fray of the human marketplace. His "Prayer for My Son" suggests the complex tissue of the heart that so doted on bamboo's "dear princely joints."

At a child's birth, fathers generally hope for a smart baby.
Wits wrecked my life, so let's hope this fellow
turns out dull enough to get on in the world
and enjoy his senility in high government office.

The prayer also provides an excellent portrait of office mind from an art mind, wind's-eye view. Wise counselors have declared it "off the bamboo bull's eye," but against their better judgment we include it as a sample of the toughness of mind of China's most famous fanatic or beau of bamboo.

Su Tung-p'o held office himself with his art mind firmly intact. Once while he was doing duty as judge in a small claims court, a poor defendant excited his sympathy. Su Tung-p'o called for brush and paper, quickly sketched a branch of bamboo and cluster of leaves, and gave it to the man to sell and pay his debt.

By the nature of Chinese calligraphy, poetry and painting there were much more closely allied than in the West. Most paintings included a brief

poem in the margin, and, just as bamboo was a favorite subject for a sketch, poets vied with one another in praise of the plant. Su Tung-p'o, with a smile up his sleeve, once wrote a boast for bamboo departing from a story about Confucius, who reputedly became so absorbed in the melodious sighing of bamboos that he forgot to taste meat for three months and remarked to a friend: "People get thin without meat, but without bamboo they get vulgar."

*Plain but good
for my food,
for my bed,
a straw mat.*

*Would I whine at my fate
or pine to get fat
with bamboo at my gate
to doctor my mood?*

*No cash? You grow thin
in the paunch and the purse.
No bamboo? You get coarse
and your thinking runs thick.*

*The skinny or sick
can get plump again
and fate sometimes switches
from squalor to riches—*

*but the dummies you meet
in palace or street
in general wax worse
from cradle to hearse.*

—Su Tung-p'o



Blackening the silk.

Rich in cultural reference, placing the ultimate challenge on wrist and fluid brushwork of the ripest talent, ubiquitous in nature, coddled beauty of the rich man's garden, tough friend in a dozen daily uses to the poor, bamboo became as tenaciously rooted in the artistic traditions of China as the plant itself was anchored in her mountains. More common longer as a subject than the naked human figure in the West, manuals multiplied on painting techniques. Li K'an (A.D. 1245–1320) in his *Bamboo Treatise* compiled a classic statement of the art: "To paint bamboo, carry the whole matter first in the mind. Then seize the brush, concentrate your attention, go straight ahead and follow what you see as quickly as the hawk swoops when the hare jumps out. If you hesitate for a single moment, it is gone! It isn't making joint after joint and piling up leaves. . . . Every leaf, curved or straight, slanting down or pointing up, beaten by rain or fluttering in the wind, has its own appearance. If they're all made the same, you're just blackening the silk." (Sze.)

Some say that a woman by moonlight painted the first bamboo:

*Empty and receptive,
Lady Li traced shadows of bamboo
the moonlight cast on
paper of a window screen:
the lean of each leaf,
the bend of each branch,
complete in the mind before beginning.
Then, from the heart in order,
power flows which shoves the brush to action
with confidence and ease.*

This is an interesting method for the amateur artist, by moonlight, noonlight, or lamp. Arrange a paper on a wall or ground beneath a plant, and let the brush dance in the shadows. This is one way, at least, to begin the apprenticeship. There is no end.¹⁷

THE YELLOW BELL

A single, eternal note sounds at the center of Chinese musical theory and forms the cornerstone of good government. This fundamental tone is called *huang chung*—"the yellow bell." Emperor Huang Ti (3000 B.C.) assigned Ling Lung, the "music ruler," the task of determining correct pitch. Ling went to the westernmost edge of the kingdom, where he cut a piece of bamboo and blew into it. The note was the pitch of a man's voice when he spoke without passion.

—Rita Aero¹⁸

The voice without passion: *wu wei*, the art of not doing.

Ling then cut the rest of the scale in accord with this primal note, returned to the court, and tuned the emperor. The emperor tuned the ministers, they in turn tuned the functionaries of the state, and these then governed the people with minimal intrusion—in a voice without passion.

The mist-hid mountain, the word unspoken, the note not blown all dominate the painting, poetry, and music of Eastern art, and many Eastern theories of government reflected the same principle: *wu wei*, not doing, was an art every bit as crucial as doing. "Govern people as you cook small fish," says Lao Tzu—poking as little as possible.

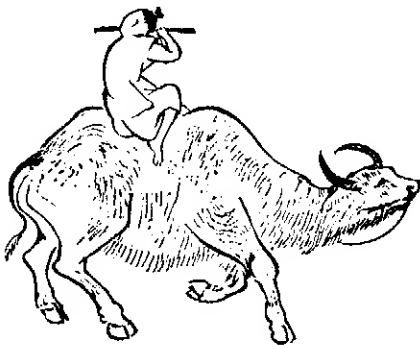
Music was the nondoing of correct government: Better to move men from inside with pitch and rhythm than with external compulsion and laws.¹⁹

"Music is a higher revelation than philosophy or science," Beethoven contended. Ling and many other early Chinese masters of music would agree heartily. Most anciently, music was a tool, designed to achieve specific effects, in politics, medicine, and agriculture. The shaman's drum helped him travel to other dimensions from which he returned to his local physical neighborhood with healing power and news of the invisible. People of knowledge or healing used song and rhythm as a raft to other shores.

In India, the science was sufficiently perfected to create ragas that influenced not only plant growth but also even weather. Since all life is pulsing with vibration, the trick was to find sounds that resonated with nature and so massaged the natural harmonies of matter with sound. The Chinese prescribed different types of instruments for different seasons:

In summer, silkworms' work is encouraged with the zither's silk strings. In autumn, bells were the appropriate instrument, for they were used in retreat in battles. In winter, drums—used to advance in wartime—encouraged the sun to return. In spring, when men desire trees to bud and crops to grow, the most potent instrument would naturally be one of bamboo, a plant of such vitality that it remains green even in the winter snow. The various pipes of bamboo, then, through which men's *ch'i* causes a similar *ch'i* in Nature to respond, were the instruments of spring.²⁰

Modern experiments confirm the "soundness" of early oriental practice. The fundamental metabolic processes of plants, such as transpiration and carbon assimilation, were quite accelerated, and they increased over 200 percent in comparison with controls, when excited by music or a rhythmic



beat. A chapter in *The Secret Life of Plants* is devoted to the influence sound has on plant growth, a reality well documented by a number of investigators throughout the world.²¹ Many an ancient commonplace is weird news to the nowadays ear. We usually think of music, for example, as of human origin—but earlier cultures believed in "the music of the spheres." And earth has its music, too.

The music of people is made on flutes and drums.

The music of earth sings through a thousand holes—

mooing and roaring, whistling and grumbling, high pitched and screaming—one call awakens another . . .

Have you listened then how everything trembles and dies down?

Such is the music of people and earth.

And the music of heaven?

Something is blowing on a thousand holes.

Some power stands behind all this, beyond sound and silence.

What is this power?

—Chuang Tzu

FLUTES CAME BEFORE FINGERS

Flutes came before people. The wind made them and played them. One culm leaning on another rubbed holes the weather whispered through; birds pursuing bugs or building nests drilled other notes in other internodes. Long afterwards, the human race came wandering down the path of spontaneous mutation and built their villages beside the

groves. Bamboo moaning in the windy midnight made melodies that seemed played by spirit fingers, strange lips, a ghost orchestra of ancestors come to mumble down the long tube of dreams . . .

Weeping bamboos.

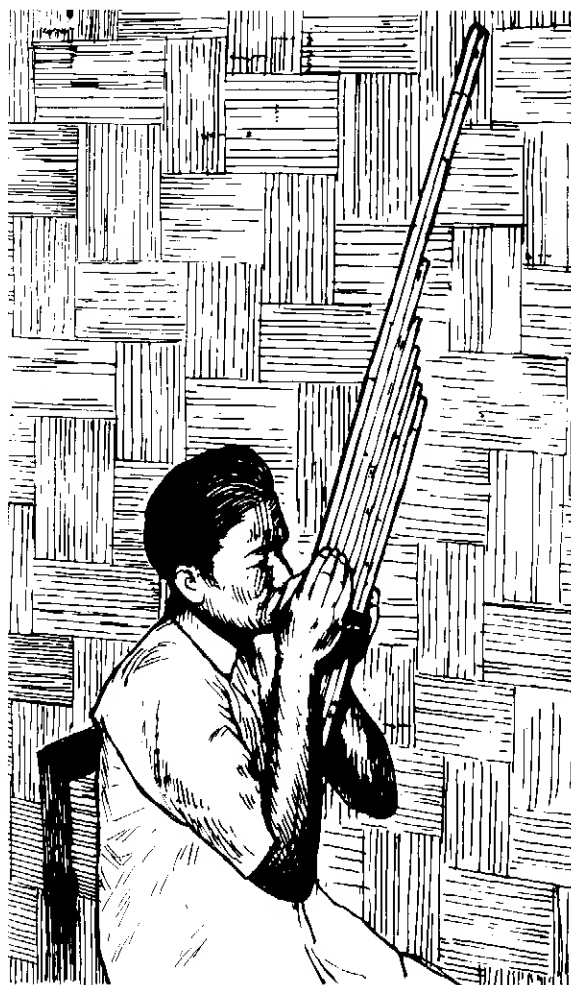
As with many inventions, the first flutes were probably the biggest ever built. Someone shaped the haphazard processes of nature into deliberate art, climbed up in the groves and experimented opening holes of different length and volume in internodes. Munro (1866) notes the persistence of this practice among the natives of Malacca, where slits in every internode produced up to twenty notes in these *bulu perindu* or "weeping bamboos," as they were called.²² (See also *flying art, kites*, and *whistle kite*, Chap. 2; see also pre-Colombian *Guadua*, Chap. 5, for Japanese and Colombian military use of this effect.)

Accordion ancestor: the *sheng*.

Birds were also early music masters to our race, and some of the earliest instruments obliquely acknowledge this ancestry:

Sweet and delicate, the sound of the mouth organ or *sheng* is said to resemble the cry of the phoenix. The instrument itself is crafted to imitate a phoenix with folded wings: Seventeen bamboo pipes are arranged in a circle and held in a gourdlike wind chest. This type of mouth organ is very ancient—characters on bone from the Shang dynasty (c. 1550–1030 B.C.) refer to it. The pipes contain reeds cut to the diameter of the pipe so that they are free, unattached . . . Each pipe also contains a finger hole. When the hole is closed, air is forced over the reed, causing it to vibrate and produce a note.²³

The *sheng* is related to the *sho* of Japan and to the most important folk instrument of Thailand, the *khāen*, generally made of about fourteen thin bamboo tubes, up to 4 inches long, each with a small free-beating metal reed. The *khāen* is usually tuned to seven pitches per octave, thus producing a two-octave range. "The bamboo pipes are put in two rows through a wooden mouthpiece, above which in each pipe a small round hole is cut. The instrument is held with the two hands cupped around the mouthpiece so that the fingers fit naturally over the holes. The hole of one pipe may be closed with a piece of wax, pitch, or other material to produce a drone. The sound of the *khāen* is often described as mournful and plaintive."²⁴ A number of similar instruments appear in Southeast Asia; in fact, the



Khaen.

sheng's notes drifted even farther from its original home.

The *sheng* works on the same principle as the reed organ and is the earliest instrument known to use that principle. In the eighteenth century, a Chinese *sheng* found its way to Saint Petersburg in Russia. A German organ builder studied it there and then introduced the free reed to Europe. By the start of the next century, Western instrument makers had applied the principle to develop the harmonica and the accordion.²⁵

At the same time that this Eastern bamboo mouth organ was bearing strange new Western offspring—the cultural kin to "hybrid vigor" in biology—a European missionary in the East was evolving the world's first bamboo organ, a musical mestizo of Spanish-Philippine descent.

Appropriate music: Philippine bamboo organ.

Just 11 miles south of Manila stands the world's

oldest and perhaps only Western-style bamboo organ, completed in 1821 and still playable in spite of all that a century and a half of unnumbered earthquakes, typhoons, termites, and a generous abundance of wars have cast against it. According to tradition in the village of Las Pinas, Father Cera, the local pastor, requested an organ from Europe in a letter he addressed to the queen of Spain. Neither aid nor apology arrived in reply for so long that he at last took the matter into his own capable hands. Helping himself to native material, local musical wind-instrument design, and Philippine bamboo building traditions, in three years he constructed an organ 14 feet high, with 950 pieces of bamboo, which 163 years later remains incredibly intact, in tune, and in use. As a quite effective preservative measure, the friar buried his bamboo six months in sand before starting to build. It would be interesting to know the bamboo species used.²⁶

BAMBOO ORCHESTRA

In the 3½ millenia between the earliest sheng and the Philippine organ, there have been so many wind, string, and percussion instruments made of the plant wherever it flourishes that any student of bamboo music would agree that "in every bamboo bush are hidden the instruments for a whole orchestra."²⁷ Borrowing a line from Shelley, Freeman-Mitford (1899) called bamboo "the slave of music."

Trumpets, didjeridu, bocina, quenás, rondadores.

Some version of a bamboo trumpet, for example, is found throughout Melanesia. A large bamboo tube, closed at one end by a node in which a hole has been made, is played by buzzing the lips against the hole. Similar instruments exist throughout the world. The *didjeridu* of Australian aborigines is an impressive bamboo wind instrument made from a hollowed tube 5 to 6 feet long, 2 to 4 inches in diameter, with a mouthpiece of beeswax.²⁸ In Ecuador, a trumpet called a *bocina*, made from a single 5-foot internode of a bamboo locally called *tunda* (*Aulonemia queko*), is used for a message system in the mountains around Otavalo. Better known in the Andes are *quenás*, bamboo vertical flutes, and *rondadores*, bamboo panpipes of various sizes, both increasingly familiar with the recent adoption of Andean music by young Latinos as a musical form of anticolonialism, a regional counteroffensive to multinational electronic rock.

Valiha.

In New Guinea, the jew's harp, rattles, simple xylophones, and even a string instrument are made from bamboo. Their bamboo zither resembles the *valiha* from Madagascar, which is similarly constructed. Strips cut in the silica-rich skin of the culm, with both ends left carefully attached, function as strings. Small wooden bridges wedged under them lift the strips above the culm surface for strumming.²⁹

"The Jakoons in Malacca make also a sort of guitarre consisting of a bamboo tube about a foot long, on which are lengthwise strained three or four strings which rest on small pieces of wax instead of a bridge."³⁰ As a flying footnote, it's worth noting that calling these instruments trumpets, zithers, or guitars roughly approximates their reality, but implies a Eurocentric—and myopic—vision of *Music of the Whole Earth*.³¹

Raft pipes and bundle pipes.

Some of these instruments, such as the bamboo "zithers" made in Nigeria and other countries, seem made in spite of limitations of bamboo. Others, especially flutes, are designed in complete agreement with the natural properties of the plant.

A scan of a handful from a single country will suggest the impossible amplitude of our theme. In China, bamboo is used in a number of flutes and



Trumpet. "La Bocina" summons workers to eat near Otavalo, Ecuador.

wind instruments in addition to the sheng discussed above. A set of bamboo pipes stopped at the lower end, the *p'ai hsiao*, is among the most ancient. Twelve, later sixteen, pipes were bound together in a circle ("bundle pipes") or in a row ("raft pipes") and blown from above across the opening. The *ch'ih*, perhaps the world's first cross flute, was a six-hole bamboo flute mentioned in a ninth century B.C. ode, played with the *hsuan*, a bone or earthenware wind instrument dating from the Shang dynasty (1550–1030 B.C.), shaped like a small barrel about 2½ inches high with a hole in the top. "Heaven enlightens the people when the bamboo flute responds to the earthenware whistle."

The *ti*, another bamboo cross flute said to have come from Central Asia around the first century B.C., is in its present form 2 feet long with six finger holes. Just below the mouth hole, a seventh hole is covered with rice paper to make a buzzing tone that accompanies the notes. Two more holes are used to tie an ornamental silk tassel to the end of the instrument.

The *hsiao* and the *yueh* are vertical flutes, the first with the mouthpiece cut through a node that closes the *hsiao* at the top. The *yueh* (meaning "foot" or "measure" or "stalk") was tuned to the *huang chung*, the "yellow bell," or fundamental note. The instrument measured an old Chinese foot in length—22.99 cm or 9.06 inches. "The distance between holes was determined purely by measurement: The center of the lowest finger hole was 3 Chinese inches from the bottom, the other holes all 2 inches between their centers. A scale requires holes spaced farther apart towards the lower end of the instrument. For proper pitches to be played on a Chinese flute, the size of the holes would have to be varied or the player would have to make adjustments in fingering and breathing."³²

Voice of the dead.

From Egypt to India, thence to China came an instrument—the *sebi*—which around the Tang dynasty (A.D. 900) evolved closer to the shape of its present-day descendant, the *shakuhachi*, a Japanese vertical flute some 1.8 feet (54.5 cm) long with four holes on top and one below.

A Zen Buddhist sect of mendicant musicians—the *komuso*, "priests of empty nothing"—wan-



Shakuhachi.



Priests of Empty Nothing.

dered Edo playing bamboo flutes as part of their begging style, wearing bamboo baskets over their heads for anonymity. A group of them formed the Fuke sect, forged some documents making them appear more ancient and venerable than they were, and persuaded the shogun to grant them a monopoly on the flute and basket begging format. In exchange, they roamed the red-light district and other areas of old Edo as itinerant ears of the shogun, pausing at the paper windows on the dark streets playing the breathy, eerie music that, on first hearing it, Mahatma Gandhi, weeping, called "the voice of the dead." Between haunting notes, they kept their ears open inside their baskets for useful information. Buddhists are generally nonviolent, but the Fuke were often samurai stripped of their swords. Weaponless by government decree, in time they redesigned the shakuhachi to double as a club: it began to be cut from the heavy basal section of the thick-walled *madake* (*Phyllostachys bambusoides*).³³

Creation by subtraction: hollow + hollow = flute.

Flute-making was a perfect embodiment of the Confucian art principle that a work was finished not by adding the last lacking, but by taking the last extra away. The simplest bamboo flute is indeed constructed by subtraction. And the new holes in the original vacancy reflect the circular emptiness of the bamboo itself. Hollow plus hollow equals flute, a trembling void.

Considering the simplicity of its structure, the

emotional complexities of its effects are all the more interesting. Characteristically described as indescribable, eerie, of a strange mournfulness, the flute echoes a basic ache of the soul stretched between the imagined and the embodied. The flute has always been the lightweight companion of wanderers, wind-whipped shepherds, homeless gypsies playing to a lonely immensity of stars. Flutes are more of the mountain and open field than of the street or living room, and when they are played in more civilized surroundings, they often seem a sound in exile, from another world or another, more inward dimension—from cosmic rather than merely social strata of our being.

The shrewd use of the bamboo flute by the "priests of empty nothing" resonated with a rich traditional alliance between the Eastern spirit and the plant. The komuso were a late, brief moment in a bamboo parable that runs for centuries through oriental spiritual imagination.

BAMBOODHISM: SOMETHING ABOUT NOTHING

In a river mist, if another boat knocks against yours, you might yell at the other fellow to stay clear. But if you notice, then, that it's an empty boat, adrift with nobody aboard, you stop yelling. When you discover that all others are drifting boats, there's no one to yell at. And when you find out you also are an empty boat, there's no one to yell.

—Chuang Tzu

"Yesterday upon the stair, I saw a man who wasn't there. He wasn't there again today. I wish that man would go away." Only a silly jingle—but it embodies accurately the Western mind's discomfort with nonbeing. In the skies constructed by Western theologians, there is only a Supreme Being: "I am Who am." A Supreme Nothing is almost unthinkable in the West, while our planet neighbors in the East have always been very much at home in the void. Empty among them is an honored guest. With micro- and telescopes, Western scientists have recently discovered that there is much more nothing than something. The gaps have gradually appeared

so much more ample than the atoms, space so much vaster than stars, that siding so rambunctiously with being has begun to seem more fragile after all than that ease with emptiness which has, for millennia, remained a central feature and patrimony of the East.

*A cup is made
of bottom and sides—
but its use
lies in emptiness.*

*A house is made
of roof and walls—
but its use
lies in emptiness.*

*The greater the road,
The greater the emptiness.
Something about nothing
makes us able to use
what's there by what isn't.*

*So, tell me, please,
which you like best:
being . . .
or nothingness?*

—Lao Tzu

In a mind climate so amiable with absence, it was only natural that, of all the useful pieces of bamboo, the part that most firmly rooted the plant in Chinese affections was the part that wasn't there. Radiating into every corner of the culture from its hollow core, bamboo became a natural symbol for that "flexible emptiness" regarded particularly by the masters of Zen as the subtle center of spiritual development. In fact, to "trim bamboo" was a Chinese phrase meaning to become a Buddhist.³⁴

Hollow design.

From a botanical viewpoint, we might remark that the abundance of bamboo derives in great measure from its capacity to leap immediately to full growth, which, in turn, depends largely on its emptiness. Instead of sanely constructing itself inch by solid inch like trees, soberly climbing into the contested forest air, bamboo sprints sunward to complete stature in about two months. We people attain our



total altitude in maybe fifteen years—say a quarter of our average lifetime. Although its wood is fully seasoned and mature in three to five years, a bamboo culm can easily stand as long as ten or more. In $\frac{1}{60}$ its total lifetime, it is as tall as it will ever be. To pursue our human analogy, it is as if we were fully grown by our first birthday. After this initial vertical burst, bamboo unfolds branches and uncoils leaves to capture the sunlight it leapt up to get. As a survival tactic among many plant species reaching up to compete for available light, the growth pattern of bamboo is shrewdly designed. And it revolves around a basic emptiness— $\frac{2}{3}$ of its volume in thin-walled species, $\frac{1}{3}$ in those with thick walls, never has to be born or fed. The nutrients and moisture that would have been exhausted making and maintaining this empty center can be utilized for growth of other culms.

Nine uses of void.

The utility as well as vitality of bamboo depends greatly on that part of it so fortunately absent.

With its internal septae removed, bamboo forms a natural pipe, and this fact exerted a cardinal influence on East Asian invention. In the earliest times it offered itself as a material for flutes and pipelike instruments of music, instruments which deeply moulded the development of Chinese acoustics through the ages . . . Then it was turned to great effect from the Han onwards in the conveyance of brine from the deep springs to the places where evaporation was to take place. It also found use in piped water installations. Cut longitudinally it served for light tiles on roofs and every sort of simple channel. But bamboo tubing was used further in alchemy and the beginnings of chemical technology in the form of containers for such purposes as the descensory distillation of mercury and the solubilization of minerals. It generated the sighting-tube so characteristic of medieval Chinese astronomical instruments and fulfilled its most fateful destiny by becoming the ancestor of all barrel guns early in the +12th century.³⁵

Silence has a lot to be said for it.

The useful hollows of bamboo amply demonstrated to the Orient the opulence of emptiness. The healthy respect for nothing is reflected also in the feeling that silence has a lot to be said for it. A spareness of expression in poetry and a use of silences in music, unexplored by comparison in the West, are rooted in a philosophical tradition that has always carefully distinguished explanations from reality—and preferred the latter. "Since words

are given, it's good to know when to stop . . . The Path you can name isn't the Path you can walk . . . Those who know don't speak. Those who speak don't know." The *Tao Te Ching* is the briefest of world bibles and the most generous among them in its frequent warnings to beware of bibles. It was reputedly left, as the last reluctant social act of its author, at the insistence of the gatekeeper at Han Ku before Lao Tzu disappeared over the last horizon, returning to his root.

*Hold tight to Quiet and, of ten thousand things,
there's not one you won't handle.*

*I've seen them go back. Look:
whatever grows, goes back at last
to its root.*

Return to the root means "Quiet."

Quiet means accepting destiny.

Accepting destiny links us with "Always."

Knowing Always means "Lit Up."

*Not knowing it means plunging darkly
from chaos to disaster.*

—Lao Tzu

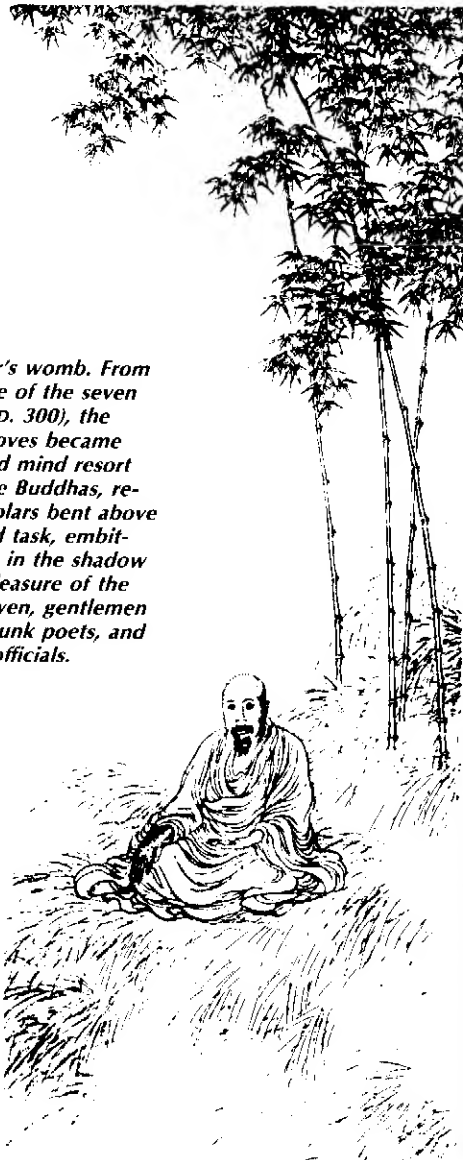
Quiet ears ripen. And the rustle of bamboo leaves, as in the case of Confucius, were a favorite "classical" sound, with a famous precedent in cultural history, which helped bring stillness to the heart and will.

The philosopher's womb.

The empty center of Buddhist cosmology was mirrored in the sage's empty will. Achieving this "silent will" often implied withdrawing from the human hubbub, and the example of the Buddha himself—who chose a bamboo grove as one of his most constant homes after his enlightenment—was imitated by many later would-be wise. The seven sages of the third century (A.D.) China, who retired from the hectic pleasures of court life to a bamboo grove where they could give themselves more fully to philosophy, provided a much-followed model for ages after them.

Monasteries multiplied, some even named after bamboo, providing an institutionalized format for withdrawal. The retreats became crowded with recluses, forming societies rife with the same ambitions, conflicts, and messy human motives they had been established to avoid. Frequently the more serious seekers of emptiness found themselves compelled to quit the monasteries stuffed full of "rice bags"—as the idle monks were sometimes called in disgust by the masters. These true pilgrims had left home for the temple. When the temple proved an-

Philosopher's womb. From the example of the seven sages (c. A.D. 300), the bamboo groves became the standard mind resort of would-be Buddhas, reclusive scholars bent above a prolonged task, embittered exiles in the shadow of the displeasure of the Sun of Heaven, gentlemen painters, drunk poets, and exhausted officials.



other home, they left it also to travel deeper into the mountains and the void.

The Tang dynasty (A.D. 618–906) was a golden moment to the literate Chinese for centuries afterwards. It was then that Zen Buddhism—*Ch'an* in China—attained the classic form that first embodied and later encased so much of oriental culture. Kyogen was a monk of those times who had spent twenty tense and fruitless years in quest of an elusive enlightenment. One day he decided to burn the useless sutras, settle far from the monastery in a mountain hut, and abandon his obsession as violently as he'd formerly pursued it.

More years passed . . . nobody counted them. Kyogen calmed down. Like Su Tung-p'o, he had a stand of bamboo at his gate to doctor his mood, serving as a green quotation from much of Chinese

cultural history. In his threadbare poverty, their erect culms reminded him that the ultimate riches were a mind without "twisty thoughts" (as Confucius called them) and a heart without scheming. "The whole universe surrenders to the quiet mind," as some burnt scripture had once told him. Or, in the words of Chuang Tzu, "Keep your will single. Don't listen with your ears, but with your mind . . . Not with mind, but with *ch'i*. The ear is satisfied with sounds, the mind with concepts: but *ch'i* is an immense emptiness ready to receive anything."

The zero zone . . . bamboo satori.

But for Kyogen, this tangle of phrases we are now recalling would long be a small pile of cold ashes. He had been alone a long time now, good medicine to rid one of the mesh of memory that clogs the mind. Truly alone forgets *alone*—and *not alone*. It forgets even the one who forgets.

Wrapped in this emptiness of memory and desire, steeped deep in mountain silences, ears scrubbed with secret scriptures of the dew, one morning cleaning his path with his bamboo broom, Kyogen swept a piece of broken tile against a bamboo culm—*konk!* In that magical moment, the membrane popped between the total texture of reality and his imagined "me." That one hollow *klunk* echoed . . . centuries down a sudden amplitude in Kyogen's skull, hollow of its last illusion. As a Buddhist nun gratefully scribbled once of that same empty moment when the mad mind halts:

*Time after time
I patched the old bucket.
Tonight, the bottom fell out.
No water. No moon.*

The tale of Kyogen's lucky ear echoed also down the minds of generations of hopeful monks. Sweeping became a chief metaphor and exercise of the Zen tradition, and another legend was added to the bamboo lore in the endless attic of Eastern consciousness.

Rush is the mother of ugly.

Aware of the cumbersome credentials bamboo holds as an accelerator of inward evolution, two young meditators in China many centuries ago entered an enlightenment pact: Together they would take only a few necessary belongings and leave a farewell note to their parents, letting them know they were ascending the local mountain to an isolated grove to descend only when complete illumination was their's.

Kyogen, on the edge of enlightenment. Hsiang-yen, his Chinese name, is less familiar in the West.



The food ran out shortly before their resolve. They got bored to unknown zones of desperation contemplating the bamboo leaves. Their blankets were wet in the improvised shelter—forget it! They packed to go down, then remembered their notes in embarrassing detail and unpacked . . . This went on a few days. The next midnight, one tiptoed out—leaving another note. Late next afternoon, the second figured he could make it to the village before dark if he left right away.

In Korea, such an evaporation of aim is called, "head like dragon, tail like snake." Modern Americans aren't the only ones in a hurry, a quality of mind that rarely reaches its point of imagined rest. Rush has always been cited by spiritual masters as a particularly vicious form of unenlightenment because it negates the very process of one by one, moment by moment, patient opening of the extra eye focused on the third time zone so few inhabit now.

An encompassing device of space and shelter that embodies much of oriental philosophy's attempt to relocate people in the calm and breathing now is the teahouse, a shelter genre more aped than truly entered in the West.

Tea's easy way.



*Tea's way's an easy way.
Roof wide enough to keep off the rain,
bowl full enough to hush hunger—
Fetch fuel and water with your own hands,
build the fire, and put the kettle on.
Arrange fresh flowers as if still living in the field.
Suggest the cool in summer and in winter,
warmth.
Burn incense. Boil water. Make tea.
Offer it at the altar, serve friends, and then
yourself.
All this is done to search the subtle meaning of
the Buddha's deeds.*

—Rikyu (1521–1591), TAPROOT OF JAPANESE TEA

HAIKU HOUSING

The bloody eyelids of the Bodhidharma.

Thus we have heard: Tea's origin lies in the eyelids of Bodhidharma ("Awake to Real"), the Indian Buddhist who brought the teachings of the Enlightened One to China around A.D. 500. Dozing off in meditation one evening, he became exasperated and ripped his eyelids off, flinging them aside. Where they landed, the first tea plant grew, with eye-shaped leaves that helped wake the mind. Tea became the special favorite of meditators, scholars, artists, and government officials, and tealore became a cup 5 fathoms deep.



Bodhidharma.



The teahouse.

The teahouse is a miniature church. Brevity of statement in poetry—haiku. Economy of material in a sparse architecture—the teahouse. The hermit's hovel, the humble shack of the recluse distant from the human hubbub in the Chinese tradition became the Zen teahouse centuries later in Japan, where it was known as the empty house, "vacancy's place." The building itself is a piece of inhabitable sculpture, characteristically small and of simple construction. Natural structural elements—bamboo, rough-hewn hardwoods, and thatch—surround ritual conventions fixed by centuries of cultural experiment.

Path and garden.

The path to the teahouse is a haiku landscape, a brief quotation, in a few stones and leaves, of the long journey to the mountain hut. Step by step, the city's smell floats off the clothes. A dozen culms of black bamboo rise in bold contrast to raked white sand beside a large fieldstone. Bamboo hoops line a pebbled path, and the guest will pass three traditional fences, all using bamboo. The outside fence surrounds the property, tall enough to block vision of the house from the street. Its principal door is of wood and bamboo, made according to time-honored designs, with a narrow bamboo roof above. The "little fence"—hardly a yard wide and no more than 4 or 5 feet tall—is used to break up space or conceal objects or portions of the house from the garden and is made also of bamboo combined with straw and other thatch.

The "inner fence" serves principally to sepa-

rate the teahouse from the garden. Traditionally very transparent, the bamboo is thinly spaced and simply, irregularly tied together in an apparently makeshift manner. It is a studied carelessness, however, reflecting one of the principal notions of the tea ceremony, to find beauty in the commonplace and imperfect. A story is told of one tea master whose son zealously swept the path immaculate and plucked the garden clean, removing the last offending twig. The father, inspecting these preparations for an honored guest, completed them by seizing and shaking a low branch of the tree above. Down drifted six dry leaves.

The ceremony of friendship.

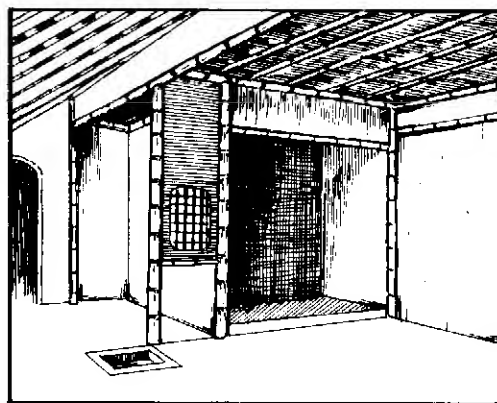
The tea ceremony gives ritual expression to the central shape of friendship: on entry, all become equal . . . and tranquil. Social status, economic rank, and all worries are left at the door with your shoes.

*Drinking a cup of tea,
I stopped the war.*

—Paul Reps

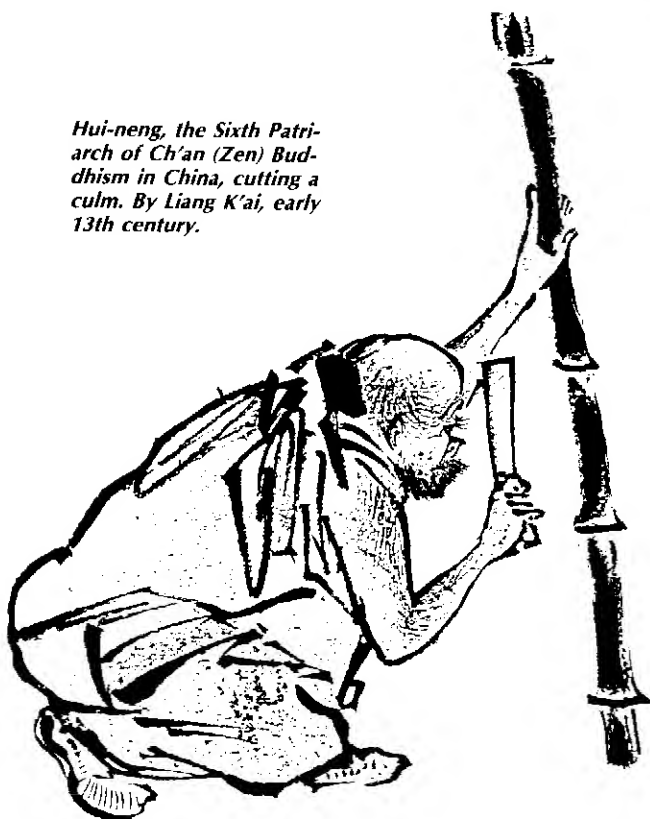
The humble tasks of boiling water, pouring tea, in the calm hands of the master become exact and intimate gestures, steeped in quiet significance. The tea ceremony is a kitchen ballet.

Bamboo is found in a number of the unpretentious utensils used to create the event. "Matcha [powdered tea] tastes better when the powder is stirred into bubbles. The stirring utensil is a tea-whisk made by splitting a culm 2 centimeters in diameter into eighty fine lacelike prongs. The feat is possible with no other plant. The tea ladle used to scoop the matcha is also made of bamboo. Craftsmen in former days vied with each other to produce



Tea room. Nan-en-ji Temple, Kyoto.

Hui-neng, the Sixth Patriarch of Ch'an (Zen) Buddhism in China, cutting a culm. By Liang K'ai, early 13th century.



the most beautiful and graceful tea utensils and some of their masterworks survive today."³⁶

The best tea ceremony utensils now cost from 80 to 500 dollars—so we have come full circle, from the hermit's humble hovel to the rich man's hobby.

But it is not as a superrefined pastime of an elite that the teahouse interests us. We are drawn not to the perfections of the external, for-sale form, but to the inner folds of meaning in teahouse traditions as they relate to present world building needs, especially among the poor, that is, most of us here.

The tao of housing: building builders.

The human scale, the use of locally renewable resources, a highly personal weaving of house and habitat, shelter and weather and leaf wed in one seamless garment—these design virtues of the teahouse are all the more relevant in a time when high-rise plastic pollution, exiled from vegetation and made by anonymous and ulcered others is the tao of modern housing. Another art has floundered down the sad path to industry. How can we help the art of housing come back home? The teahouse was not only self-built, but Self-built by masters who knew that the builder's main monument was the builder—"Build living Buddhas, not pagodas."

*In floor and ceiling,
wall and shelf,
beneath your house
you build yourself.
Work mindfully, for
calm builds most
accurate carpenters,
who make the rest.*

CHAPTER 3.

1. Porterfield 1927:50.
2. Dickason 1966:7.
3. Aero 1980:185
4. The peach is a symbol of longevity. It was said if you could taste fruit from the peach tree of the gods, you would never taste death. Han Hsiang Tzu, brought to this tree by his teacher, slipped from a branch and would have died in the fall, but he managed to bite a peach on the way down.
5. Williams 1931:151-6.
6. Assembled from phrases of Satow (1899) and Sze (1956, 1977).
7. Sze 1977: 302.
8. Ibid.: 299.
9. Ibid.: 110.
10. Ibid.: 111.
11. "The Book of Bamboo" forms a part of *The Mustard Seed Garden Manual of Painting*, published in the West as *The Tao of Painting* by Sze (1977), a paperback abridgement of a more complete text published by Sze in 1956. Citations here refer to the 1977 paperback.
12. Sze 1977:65.
13. Austin 1970:121.
14. Sze 1977:117.
15. Oi 1963.
16. Ibid.
17. A number of recent publications give details of traditional bamboo painting brushwork. See especially Sze 1956, Leong 1979, Tseng-Tseng Yu 1981, Cameron 1968. For historical background, see Cahill, van Briessen 1975, Suzuki 1971.
18. Aero 1980:168.
19. "In ancient China, music was from the beginning unmistakably linked to politics." This subject is discussed at length, May 11.
20. Needham 1980:iv.1:156.
21. Tompkins 1974:161-8.
22. See also Kurz 1876:233-4 and Lawson 1968:15 for various accounts of this practice.
23. Aero 1980:166.
24. May 1983:68.

25. Aero 1980:166.
 26. *New York Times*, 5 Feb. 1969.
 27. Kurz 1876:233.
 28. May 1983:158–61.
 29. Malm 1977:15 ff.
 30. Kurz 1876:234.
 31. The title of a highly recommended global survey by Reck 1977.
 32. Aero 1980:112.
 33. Levenson 1974.
 34. Sze 1977:275.
 35. Needham 1980:vol. iv,2,sec.27:64.
 36. Junka 1972:26. See photos of tea ceremony utensils in Austin 1970:152–9. Sen 1979 offers over five hundred photographs on tea architecture, objects, and etiquette, noting that Japan presents an example “to be kept in mind,” adapting it always to the special resources and cultural needs of new locations. Tea has no frontiers. Its path is everywhere. Its essence is “extracting essence through relationship.” *Aisatsu*, the encompassing Japanese idea of “greetings,” derives from *ai*, “friend,” and *satsu*, “drawing out the good qualities of one another by gathering together to share time.” “As iron sharpens iron, a friend sharpens the face of a friend” (*Old Testament*, Proverbs) (Sen 1979:3).
- The way of tea and its behavior is based on “the mutual contribution of the host and guest to the mood of their meeting.” The tea ceremony is a “practice,” a rehearsal ritually designed to ease tea’s way into everyday life.
- The recent flood of tea news includes: *The Way of Tea* (Rand Castile), *Japanese Arts and the Tea Ceremony* (T. Hayashiya et al.), and *Tea Ceremony Utensils*

(Ryoichi Fujioka), all from Weatherhill. See also Hammitzsch 1980 and Okakura 1906, the first book of tea published in the West. Lee (1962:395–7) provides a useful critique of the rigidities stifling the central sniff of tea: “Beginning as an informal and uncodified meeting of congenial spirits, it became a rigid cult of taste, artificially dedicated to simplicity . . . Rikyu’s four requirements for the ceremony—harmony, respect, purity, and tranquillity—are understandable defenses for the conservative and cultivated few against the robust, gorgeous, and sometimes gaudy tendencies of the new dominant classes of the seventeenth century. Two all-important tea ceremony qualities, *sabi* (‘reticent and lacking in the assertiveness of the new’) and *wabi* (‘quiet simplicity’), can also be best understood against such a historical background . . . What had begun as an informal gathering has become an exercise in studied nonchalance with overtones of repression and symbolic poverty . . . One small incense box of glazed stoneware brought almost \$40,000 in the 1930s . . . That the tea ceremony represents the essence of Japanese art, or even taste, is open to question. The many other manifestations of art in the Ashikaga, Momoyama, and Tokugawa periods should place it in proper perspective as a conservative, elite, holding action.” Fossilization, loss of original energy, is a constant in all cultural evolution. It provides a fallow period of neglect, prologue to appropriate resurrection. Fathy’s remarks on tradition and the reactive creation of the individual that keeps tradition alive are important in this context (see pp. 116–122, “Architecture with Heart”).